ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

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PAT QUINN, GOVERNOR DOUGLAS P. SCOTT, DIRECTOR

IEPA #: 1978030004
USEPA #: ILD041550567

Permit Log #: B-162R
Notice #: PB-09-10
Initial Publication: December 31, 2010

PUBLIC NOTICE OF HAZARDOUS WASTE PERMIT RENEWAL

The Illinois Environmental Protection Agency (EPA) hereby gives notice of intent to renew a Resource Conservation and Recovery Act (RCRA) permit held by the CITGO Lemont Refinery in Lemont, Illinois located at 135th Street and New Avenue. This permit renewal would require CITGO to close and provide 30 years of post-closure care, for four hazardous waste land treatment areas, to continue facility-wide groundwater monitoring and perform any required corrective action, and to continue corrective action for waste management units facility-wide.

The interested public is invited to review copies of the permit application, draft permit and related fact sheet, at:

Lemont Public Library
50 E. Wend Street
Lemont, Illinois 60439

Written comments on the draft permit may be submitted during the 45-day comment period. Send comments to the Illinois EPA contact listed at the end of this Notice postmarked by midnight, **February 14, 2011**. In response to public requests or at the discretion of the Agency, a public hearing can be held to clarify technical issues concerning the draft permit. A public hearing request must be made in writing, express opposition to the draft permit and state the nature of the issue(s) to be raised at the hearing. Written hearing requests should be sent to the Illinois EPA contact listed below. Public notice will be issued 45 days before any hearing.

All comments received will become part of the Administrative Record (AR) and will be evaluated by the Agency in making the final permit decision. The Agency will respond to comments on the draft permit and indicate whether additional documents have been included in the AR. Commenters will be notified of the final permit decision and the permit decision appeal process.

The AR, including the permit application, draft permit, related information and all data submitted by the applicant, is now available for public inspection by appointment only Monday through Friday between 9:00 a.m. and 5:00 p.m. Please telephone the Illinois EPA contact below for an appointment to view the documents at Illinois EPA's offices in Springfield.

Mara McGinnis, Public Involvement Coordinator (#5)
Illinois Environmental Protection Agency
1021 North Grand Avenue East, P. O. Box 19276
Springfield, Illinois 62794-9276

Phone: 217/524-3288
(TDD: 217-782-9143)

For further RCRA information, go to: http://www.epa.gov/epawaste/wycd/manag-hw/e00-001a.pdf

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Unocal Corporation
1201 West 5th Street, P.O. Box 7600
Los Angeles, California 90051
Telephone (213) 977-7944

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UNOCAL 76

Walter W. Crim
Assistant Counsel

January 23, 1987

RECEIVED
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U.S. EPA, REGION V
WASTE MANAGEMENT DIVISION
HAZARDOUS WASTE ENFORCEMENT BRANCH

Ms. Beverly Shorty
Hearing Clerk
U.S. EPA, Region V
230 S. Dearborn Street
Chicago, Illinois 60604

Re: Answer and Request for Hearing
Union Oil Company of California, Respondent
Docket No. V-W-87R-015

Dear Ms. Shorty:

Enclosed please find for filing Respondent Union Oil Company of California's, dba Unocal, Answer and Request for Hearing. For your information, an informal settlement conference has been scheduled for March 3, 1987.

Thank you for your assistance.

Very truly yours,

Walter W. Crim

WALTER W. CRIM

WWC/hr
Enclosure
cc: Mary Hay (w/enc.)
Jonathan W. Cooper (w/enc.)

RECEIVED
JAN 26 1987
U.S. EPA, REGION V
WASTE MANAGEMENT DIVISION
HAZARDOUS WASTE ENFORCEMENT BRANCH

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION V

IN THE MATTER OF UNION OIL COMPANY OF CALIFORNIA 135th Street and New Avenue Lemont, Illinois 60439 ILD 041 550 567	DOCKET NO. V-W-87-R-015 ANSWER AND REQUEST FOR HEARING

COMES NOW the Respondent, Union Oil Company of California dba Unocal (herein "Unocal"), through its attorneys Sam A. Snyder, Timothy R. Thomas, Brendan M. Dixon and Walter W. Crim answers the Complaint filed in this matter by the Director, Waste Management Division, Region V, United States Environmental Protection Agency ("U.S. EPA") as follows:

1. Unocal admits it owns the facility referenced in paragraph 1 of the Complaint; that it is a person as defined in the statutory references made therein, but denies any allegation of violation which may be inferred by paragraph 1 of the Complaint.

2. Unocal admits that the regulations cited in paragraph 2 of the Complaint contain standards and requirements applicable to owners and operators who generate, transport, treat, store or dispose of hazardous wastes, but denies any

allegation of violation which may be inferred by paragraph 2 of the Complaint.

3. Unocal admits that the regulations cited in paragraph 3 of the Complaint contain standards and requirements concerning the generation, transportation, treatment, storage or disposal of hazardous waste, but denies any allegation of violation which may be inferred by paragraph 3 of the Complaint.

4. Unocal admits that the regulations cited in paragraph 4 of the Complaint contain standards and requirements applicable to persons who treat, store or dispose of hazardous wastes, but denies any allegation of violation which may be inferred by paragraph 4 of the Complaint.

5. Unocal admits that the regulations cited in paragraph 5 of the Complaint contain standards and requirements applicable to interim status, but denies any allegation of violation which may be inferred by paragraph 5 of the Complaint.

6. Unocal admits the statements contained in paragraph 6 of the Complaint.

7. Unocal admits the statements contained in paragraph 7 of the Complaint.

8. Unocal admits the statements contained in paragraph 8 of the Complaint.

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9. Unocal admits the allegation in paragraph 9 of the Complaint that representatives of Illinois Environmental Protection Agency ("IEPA") conducted a compliance inspection of Unocal's Lemont facility on May 16, 1986, but denies or admits the allegation of violations as stated hereinafter.

9a. Unocal denies the allegations of paragraph 9a of the Complaint, excepting the allegation pertaining to 35 Ill. Adm. Code 725.191(a)(1) which response is given at paragraph 9c herein. In support of its denial, Unocal submits that it responded to IEPA's concerns in a meeting held on August 28, 1986 and in two detailed technical responses dated September 12, 1986 and November 14, 1986, attached hereto as Attachments 1 and 2 and incorporated herein by reference as if fully printed herein.

9b. Unocal denies the allegations of paragraph 9b of the Complaint, excepting the allegation pertaining to 35 Ill. Adm. Code 725.191(a)(1) which response is given at paragraph 9c herein. In support of its denial, Unocal submits that it responded to IEPA's concerns in a meeting held on August 28, 1986 and in two detailed technical responses dated September 12, 1986 and November 14, 1986, attached hereto as Attachments 1 and 2 and incorporated herein by reference as if fully printed herein.

9c. Unocal admits the allegations of paragraph 9c of the Complaint in the strict sense, however, based on a review of groundwater contour maps, Unocal recognizes that the existing groundwater contours underlying the land treatment facility may preclude and/or make impractical the installation of a hydraulically up-gradient monitoring well. Unocal believes that the designated "up-gradient" monitoring wells are representatives of background groundwater quality in the underlying uppermost aquifier near the facility. Therefore, although the designated "up-gradient" monitoring wells may not comply literally with 35 Ill. Adm. Code 725, 191(a)(1), it is Unocal's position that the designated "up-gradient" monitoring wells comply with the intent and spirit of 35 Ill. Adm. Code 725.191(a)(1).

9d. Unocal denies the allegations contained in paragraph 9d of the Complaint, and in support of the denial states that the Complaint has erroneously identified the boundaries of the waste management area as delinated on Figure A-2 of Unocal's Part B permit application, and that the down gradient monitoring wells, which were previously approved by IEPA, are in compliance with 35 Ill. Adm. Code 725.191(a)(2).

9e. Unocal denies the allegations of paragraph 9e of the Complaint, and in support of this denial states that Unocal responded to the allegations contained in paragraph 9e of the Complaint in a detailed technical response dated September 12, 1986 and attached hereto as Attachment 1 and incorporated herein by reference as if printed herein fully. Said document demonstrates that the existing monitoring well construction is in compliance with 35 Ill. Adm. Code 725.191(9)(c).

10. Unocal admits the statements of fact contained in

paragraph 10 of the Complaint.

DEFENSE

In defense to the Complaint, Unocal states as follows:

1. Until August 1986, Unocal was led to believe by the representations made by IEPA that it was responding to IEPA's concerns about groundwater monitoring in a timely manner. In August 1986, Unocal was informed by IEPA that IEPA had errored in its representations to Unocal, and further informed Unocal that in order for the State to insure continued support through Federal grants, it was necessary for IEPA to refer Unocal's case to U.S. EPA. Unocal submits that it has acted in good faith at all times in response to the requests of IEPA and that the imposition of a fine and/or compliance order is unwarranted.

For the foregoing reasons, Unocal requests that the Complaint be dismissed.

Unocal requests that a hearing be held on this matter.

Dated: January 23, 1987

Respectfully submitted,

By: Walter W. Crim

WALTER W. CRIM
Union Oil Company of California
1201 W. 5th Street
Los Angeles, CA 90017
(213) 977-7944

UNOCAL RESPONSE

TO ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

JUNE 26, 1986 PRE-ENFORCEMENT CONFERENCE LETTER

ATTACHMENT A

1) IEPA COMMENT

1. Pursuant to 35 Ill. Adm. Code 725.190(a), the owner or operator of a surface impoundment or land treatment facility must implement a groundwater monitoring program capable of determining the facility's impact on the quality of the groundwater in the uppermost, and all hydraulically connected, aquifers. The number, depths and construction of the current monitoring wells, as discussed below, indicate that the current program is inadequate. Additionally the following geologic/hydrologic information is needed in order to complete an adequate review of the geologic/hydrogeologic system.

   a. in-situ hydraulic conductivity tests on the screened intervals;

   b. hydraulic conductivity data on the silty-clay and clayey-silt tills;

   c. the physical properties of the dolomite (including hydraulic conductivity, porosity, potentiometric data, degree of interconnection with the unconsolidated deposits and lower aquifers, fractured or weathered zones, flow rate and flow direction);

   d. structural contour map(s) of the dolomite; and

   e. the effect of the Chicago Sanitary and Ship Canal and the I and M Canal on local groundwater conditions.

RESPONSE

It is UNOCAL's opinion that the existing detection monitoring system fulfills the intent of 35 Ill. Adm. Code 725.191 We recognize, however, that because of the number and variety of past submissions, that all relevant information may not be available to reviewers. Therefore, we have prepared a summary which integrates and expands where necessary past submissions to the Illinois Environmental Protection Agency. This summary is contained in Attachment 1, and contains relevant information which is necessary to characterize the hydrogeologic environment of the UNOCAL land treatment facility.

On the basis of Attachment 1 and the recommendation of the United States Environmental Protection Agency - Environmental Engineering Committee - Science Advisory Board, UNOCAL believes that the hydrogeologic environment underlying the Chicago Refinery's land application area has been adequately characterized, and requires no further investigative effort.

Section 725.190(a) of 35 Ill. Adm. Code states:

"The owner or operator of a surface impoundment, landfill or land treatment facility which is used to manage hazardous waste must implement a groundwater monitoring program capable of determining the facility's impact on the quality of groundwater in the uppermost aquifer underlying the facility, except as Section 725.101 and paragraph

(c) provide otherwise."

Therefore, there is no promulgated regulatory basis to require monitoring of all "hydraulically connected aquifers". Rather, it appears that the phrase "hydraulically connected aquifers" has been incorporated from the draft RCRA - Groundwater Monitoring Technical Enforcement Guidance Document (TEGD). The draft TEGD should not be and in fact is not an extension of promulgated regulations. Rather, as recommended by the United States Environmental Protection Agency - Environmental Engineering Committee - Science Advisory Board (SAB) in their "Report on the Review of the RCRA Ground-Water Monitoring Technical Enforcement Guidance Document" dated March 1986:

"The Committee recommends that the TEGD be much more explicit in stating that it is a guidance document only, and requires informed judgement in its application and use." (SAB, p.4)

Therefore, as the title clearly states, the TEGD is to be used only as a guidance document and not a "cookbook" for regulatory compliance. This concern was expressed by the SAB when they stated:

"In the public testimony which was a part of the Committee's review process, many individuals expressed the concern that the document would be used, particularly by persons with little or no experience in the design and operation of monitoring systems, to set specific requirements, such as number and location of monitoring wells, well materials and screen lengths, where such requirements could not be justified by the physical situation. It must be made very clear that the TEGD requires informed judgement in its application and use. This report proposes changes that should substantially reduce the likelihood of these kinds of problems." (SAB, p.4)

Specifically, some of the recommended changes which are directly applicable to UNOCAL include the following:

- "The Committee recommends that the procedures specified for the design of detection monitoring systems be made more efficient, and that substantially more flexibility be encouraged in addressing the primary objective, that of determining the direction and magnitude of flow of potential pollutants." (SAB, p. 5)

- "A number of terms used in the TEGD need to be redefined to make them more specific, consistent with generally accepted practice and consistent with the objective of protecting usable water supplies.

Definitions of terms such as bedrock, aquifer, uppermost aquifer, water table and hydraulic interconnection are not consistent with standard definitions." (SAB, p. 5)

- "The entire discussion in the TEGD related to detection well spacing should be revised to better reflect the purpose of the monitoring.

There should be a clearer distinction drawn between <u>detection</u> monitoring systems and <u>assessment</u> monitoring systems. Arbitrary well spacings should not be specified, but rather should be determined on the basis of site hydrogeological characteristics (as previously determined) and the requirement to determine the magnitude and direction of groundwater flow." (SAB, p. 5)

- "The site can be considered "characterized" at such a time as the geologic materials, groundwater level, and groundwater flow direction (in the different geologic units), can be accurately predicted before drilling." (SAB, p. 10)

- "The addition of the phrase "overlying or perched water-bearing zones" to the definition of uppermost aquifer substantially expands the concept of aquifer from that included in the original regulations by including any water-bearing zones above the aquifer regardless of their ability to yield water to a well, regardless of whether or not the zone is saturated, and regardless of the ability even to sample the overlying water. Included would be overlying clays and other tight formations that are of very low permeability. This definition of uppermost aquifer is much more expansive than the definition of aquifer and needs to be reconsidered." (SAB, p. 14)

- "For the purpose of this Guidance, we offer the following definition of an aquifer:

  "An aquifer is a permeable and porous geologic unit that can transmit significant quantities of fluid under ordinary hydraulic gradients, and is capable of development as a source of water for human, industrial, agricultural or other beneficial use." (SAB, p. 14)

Based on the above, UNOCAL concurs with the SAB comments, and is of the following opinion:

1) The existing draft TEGD is technically flawed and for this reason alone should not be used as a cookbook guidance document for regulatory compliance.

2) Even after the draft TEGD has had appropriate technical revisions, it should be considered a guidance document only, and requires informed site specific judgement in its application and use.

On the basis of the above, UNOCAL will reject the imposition of regulatory mandates, if those mandates are based solely on technically flawed guidelines and/or the inappropriate application of standard technical terms as contained in portions of the draft TEGD. UNOCAL will, however, work co-operatively with regulatory agencies, if regulatory requests have a reasonable technical basis and are directed toward achieving the objectives of a technically and environmentally sound detection monitoring program. Specifically, UNOCAL agrees with the SAB in that:

"There should be a clear distinction made between detection monitoring systems and assessment monitoring systems, mainly in the interest of cost effectiveness. The purposes of detection is, simply, to assess the presence or absence of a contaminant. Assessment monitoring is used to determine the location and extent of contamination and possible methods of mitigation. The two monitoring systems need not make use of the same wells" (SAB, p. 15) and, "the purpose of site characterization work is to identify avenues and direction of ground water (contaminant) flow. No arbitrary spacing should be specified. Monitoring wells should be located in those areas where pollution migration is most likely to occur, based on the hydrogeological characterization of the site." (SAB, p. 15)

On the basis of the above, it is UNOCAL's opinion that the existing detection monitoring system fulfills the intent of 35 Ill. Adm. Code 725.191 We recognize, however, that because of the number and variety of past submissions, that all relevant information may not be available to reviewers. Therefore, we have prepared a summary which integrates and expands where necessary past submissions to the Illinois Environmental Protection Agency. This summary is contained in Attachment 1, and contains relevant information which is necessary to characterize the hydrogeologic environment of the UNOCAL land treatment facility.

On the basis of Attachment 1 and the recommendation of the United States Environmental Protection Agency -Environmental Engineering Committee - Science Advisory Board that:

"The site can be considered "characterized" at such a time as the geologic materials, groundwater level, and groundwater flow direction (in the different geologic units), can be accurately predicted before drilling." (SAB, p. 10)

UNOCAL believes that the hydrogeologic environment underlying the Chicago Refinery's land application area has been adequately characterized, and requires no further investigative effort.

2) IEPA COMMENT

Pursuant to 35 Ill. Adm. Code 725.190(b), the owner or operator must install a groundwater monitoring system which meets the requirements of Section 725.191. As described below, the number and depth of the monitoring wells are not sufficient to meet the requirements of Section 725.191.

RESPONSE

Section 725.190(b) of 35 Ill. Adm. Code states:

"Except as paragraphs (c) and (d) provide other-wise, the owner or operator must install, operate and maintain a groundwater monitoring system which meets the requirements of Section 725.191 and must comply with Sections 725.192 through 725.194. This groundwater monitoring program must be carried out during the active life of the facility and for disposal facilities during the post-closure period as well."

The only substantive requirements of this comment which are not repeated in subsequent IEPA comments are that groundwater monitoring be conducted during the active life of the facility and for disposal facilities during the post-closure care period as well, and that Sampling and Analysis, and Record Keeping and Reporting be performed in accordance with Sections 725.192 and 725.194, respectively. UNOCAL has complied with these requirements since the inception of RCRA, and will continue to comply throughout the active life and post-closure period of the land treatment facility. The response to IEPA comment No. 2 is contained in responses to IEPA comments Nos. 3, 4 and 5.

<u>3,4 and 5</u> <u>IEPA COMMENTS</u>

3. Pursuant to 35 Ill. Adm. Code 725.191(a)(1), groundwater monitoring system must consist of an adequate number of upgradient monitoring wells. Upgradient wells must be installed that provide representative background samples for the dolomite aquifer and any hydraulically connected unconsolidated deposits. The construction of these wells should be such that the aquifer and the unconsolidated deposits can be monitored exclusively. This

will require well screens of no more than ten feet.

4. Pursuant to 35 Ill. Adm. Code 725.191(a)(2), the groundwater monitoring system must consist of an adequate number of downgradient monitoring wells. The number, depths and locations of the current wells are inadequate to immediately detect any statistically significant amounts of hazardous waste or hazardous waste constituents in the groundwater for the following reasons:

   a. Downgradient wells are, at a minimum, 500 feet apart. The facility must provide a justification for this well spacing and provide additional wells, if necessary.

   b. Cross-sections and boring logs indicate that the present wells monitor as many as four lithologic units.

5. Pursuant to 35 Ill. Adm. Code 725.191(c), all monitoring wells must be screened and sand packed as necessary to allow for the collection of acceptable samples. The annular space above the sampling interval must be sealed with a suitable material, i.e., cement grout or bentonite slurry. The large screened intervals (20 ft.), the excessive sand packs (40 ft.) and the use of natural clay as a backfill material combined make the current monitoring wells unacceptable.

RESPONSE

It is UNOCAL's position that the existing monitoring wells are constructed in a manner that complies with the regulations and provide representative samples of the uppermost aquifer.

For convenience of commenting, the above comments can be grouped into the following categories:

a) Location of upgradient wells

b) Location of downgradient wells

c) Number of upgradient wells

d) Number of downgradient wells

e) Well construction

Additionally, the regulations applicable to the referenced sections of 35 Ill. Adm. Code state:

"Section 725.191 Groundwater Monitoring System

a) A groundwater monitoring system must be capable of yielding groundwater samples for analysis and must consist of:

1) Monitoring wells (at least one) installed hydraulically upgradient (i.e., in the direction of increasing static head) from the limit of the waste management area. Their number, locations and depths must be sufficient to yield groundwater samples that are:

A) Representative of background groundwater quality in the uppermost aquifer near the facility; and

B) Not affected by the facility; and

2) Monitoring wells (at least three) installed hydraulically downgradient (i.e., in the direction of decreasing statistic head) at the limit of the waste management area. Their number, locations and depths must ensure that they immediately detect any statistically significant amounts of hazardous waste or hazardous waste constituents that migrate from the waste management area to the uppermost aquifer.

c. All monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole. This casing must be screened or perforated and packed with gravel or sand where necessary to enable sample collection at depths where appropriate aquifer flow zones exist. The annular space (i.e., the space between the borehole and well casing) above the sampling depth must be sealed with a suitable material (e.g., cement grout or bentonite slurry) to prevent contamination of samples and the groundwater."

On the basis of the above, there again appears to be an extension of existing promulgated regulations to include recommendations presented in the draft groundwater TEGD. UNOCAL has already stated its position and concerns regarding the draft groundwater TEGD, and for the sake of brevity, will not repeat them in response to IEPA comments Nos. 3, 4, and 5. Rather, we will respond to IEPA comments in accordance with the categories outlined above.

a) Location of upgradient wells - On the basis of the summary information contained in Attachment 1, UNOCAL's Phases I and II Groundwater Assessment Reports, and UNOCAL's - Part B permit application, there is little question that monitoring wells MW-1, MW-2 and MW-9 are located hydraulically upgradient of the land treatment area.

b) Location of downgradient wells - On the basis of the summary information contained in Attachment 1, UNOCAL's Phases I and II Groundwater Assessment Reports, and UNOCAL's - Part B permit application, there is little question that monitoring wells MW-4, MW-5, MW-7 and MW-8 are located hydraulically downgradient of the land treatment area. Additionally, although the IEPA has elected to reject monitoring wells MW-3 and MW-6 as downgradient wells because they are not located along the downgradient land treatment area boundary, UNOCAL is of the opinion that these wells are probably the most sensitive for potential contaminant detection since they are located immediately under the land application area. It should be stressed that potential contaminant migration from the land application area will first occur vertically as infiltration from the land treatment area to the top of the water table (i.e., uppermost aquifer) underlying the land treatment area. Once potential contaminants have reached the uppermost aquifer, they will then migrate at a rate and in a direction as determined by the site characterization. In the case of the UNOCAL facility, this would be northwesterly at a rate of approximately 2.3 x 10^{-3} ft/day. Therefore, excluding possible dilution and attenuation considerations, potential contaminants detected at, for example, MW-3 would require a minimum of approximately 1,000 years to be detected at MW-5 which is located hydraulically downgradient of MW-3. This example is not intended to exclude the usefulness of downgradient perimeter wells which UNOCAL has installed and routinely monitors. Rather, it simply illustrates that if the regulatory agencies are concerned with the "immediate" detection of potential contaminants, interior wells are an extremely useful component of a detection monitoring program. Additionally, it should be pointed out that the concept of land treatment is fundamentally different from that of hazardous waste impoundments, landfills, etc., which by their basic design (i.e., liner system) preclude the installation of monitoring wells within the waste management area. However, these hazardous waste management units do require leachate monitoring immediately below the secure management area (generally below and/or between the liners), which is analogous to interior monitoring wells such as MW-3 and MW-6. Therefore, the use of interior wells, lysimeters, perched water wells, and soil core samples can all be considered indicators for the onset of potential contamination.

As a consequence of the above, and despite better judgement, UNOCAL is currently planning to abandon and plug monitoring wells MW-3 and MW-6. Additionally, UNOCAL is currently evaluating, by modeling, the need for supplemental perimeter wells which, if required, are not likely to be as sensitive in the detection of potential contamination as monitoring wells MW-3 and MW-6 which were not allowed for detection monitoring by the IEPA.

c) <u>Number of Upgradient Wells</u> -

At present, UNOCAL has three upgradient monitoring wells, and is of the opinion that the upgradient groundwater quality is adequately characterized by these wells. Regulatory agencies, however, are of the opinion that if false positives result during the application of the Student t-Test, additional upgradient wells are required. This concern is probably valid if only one upgradient well is utilized. However, this is probably not a valid concern when three upgradient wells are routinely monitored. Rather, the reason for the occurrence of false positives is that the Student t-Test is an inappropriate statistical method to be utilized in the evaluation of groundwater quality data. The general reasons for this conclusion are contained in UNOCAL's Part I and II Groundwater Assessment Reports. Specifically, the problem lies in the method for evaluating the individual monitoring well which is compared to baseline values using the equations presented in 40 CFR Part 264 Appendix IV. In this calculation, the t-values and the variance for the individual well are calculated on the basis of replicate analysis of a single groundwater sample. Therefore, the t-value and variance are a measure only of analytical precision. This is not the same as the degree of variability which may be observed if, for example, replicate samples were individually analyzed and collected over a four day period (e.g., one each day). As a consequence, for those analytical methods where the degree analytical precision is high (i.e., pH and specific conductance), the variance for the individual well is low which causes the calculated t-statistic (t*) to appear significant. This can result in many false positives. Conversely, for those analytical methods which are less precise (i.e., TOX and TOC), the situation is less pronounced. In both cases, however, the t-statistic calculated is at least partially a function of laboratory precision which has little or nothing to do with the detection of the potential onset of contamination.

Therefore, beyond a certain point, (e.g., 2-3 background wells), the inherent limitations induced by the inappropriate utilization of replicate laboratory determinations on the same sample cannot be overcome by simply installing more upgradient wells.

UNOCAL, and probably most regulatory personnel, recognize that the Student t-Test is not a good statistical method for the evaluation of groundwater. If it were done over again, the Student's t-Test would probably not have been selected. UNOCAL recognizes, however, that regardless of its merits, that during interim status, we are required to utilize a t-Test. Notwithstanding other t-Test procedures suggested or being reviewed by the EPA, UNOCAL anticipates that we will routinely be "triggered" into the groundwater assessment mode because of these statistical procedures. However, despite this likelihood, we believe it unlikely that the installation of additional upgradient monitoring wells will rectify the situation.

d) <u>Number of Downgradient Monitoring Wells</u> - The IEPA appears to be using the check list guidelines set forth in the draft groundwater TEGD. However, the United States Environmental Protection Agency's own Science Advisory Board states:

"The horizontal spacing of monitoring wells needs further consideration. There should be a clear distinction made between detection monitoring systems and assessment monitoring systems, mainly in the interest of cost effectiveness. The purposes of detection is, simply, to assess the presence or absence of a contaminant. Assessment monitoring is used to determine the location and extent of contamination and possible methods of mitigation. The two monitoring systems need not make use of the same wells.

1. Monitoring well spacing - The purpose of site characterization work is to identify avenues and direction of groundwater (contaminant) flow. No arbitrary spacing should be specified. Monitoring wells should be located in those areas where pollution migration is most likely to occur, based on the hydrogeological characterization of the site." (SAB, p. 15)

On the basis of the above, it is UNOCAL's opinion that the existing downgradient monitoring wells are sufficient in number and appropriately located to detect the onset of potential groundwater contamination and are in compliance with promulgated regulations and the recommendations of the SAB. To further verify this assertion, UNOCAL is currently implementing a groundwater modeling study to evaluate the number and appropriateness of the existing downgradient detection monitoring wells. Additionally, it is unreasonable that the IEPA is requesting additional downgradient wells to "immediately detect any statistically significant amounts of hazardous waste or hazardous waste constituents in the groundwater" when they have rejected monitoring wells MW-3 and MW-6 as being inappropriate despite the fact that the onset of potential contamination at these well locations may be detected 1,000 years before the contaminants would reach the perimeter wells.

It is important that regulatory reviewers recognize that the mechanism and nature of potential contaminant infiltration is fundamentally different at a land treatment facility from that which could occur at a hazardous waste landfill or surface impoundment. In a hazardous waste landfill or surface impoundment, a contaminant release would most probably occur for a point or nearly point source such as a breach in the liner. This would result in the introduction of contaminants into the uppermost aquifer over a small aerial extent. As a consequence, the subsequent migration and dispersion of contaminants within the uppermost aquifer would be limited in extent. Therefore, a sufficient number of monitoring wells would be required to detect the onset and migration of contamination from a zone or area underlying the waste management unit which approximates a point source. However, disposal by land application techniques relies on the topical application of waste over the entire treatment area or cell. Based on the site characterization, there are no vertical anisotropics (fault zones, etc.) in the glacial materials overlying the uppermost aquifer(s) which could act as preferred conduits for contaminant migration. Therefore, if contaminant migration into the uppermost aquifer(s) were to occur, which is unlikely because of the thickness of the overlying low permeability till, it would occur as a horizontal planar source. This mechanism of contaminant infiltration is analogous to water being topically applied to the top of a sponge and slowly "seeping" through to the base of the sponge. Based on the above, potential contaminant infiltration to the uppermost aquifer would occur over the entire aerial extent of the land treatment area or cell. As a consequence, fewer monitoring wells are required to detect the onset of potential contaminant infiltration into the uppermost aquifer.

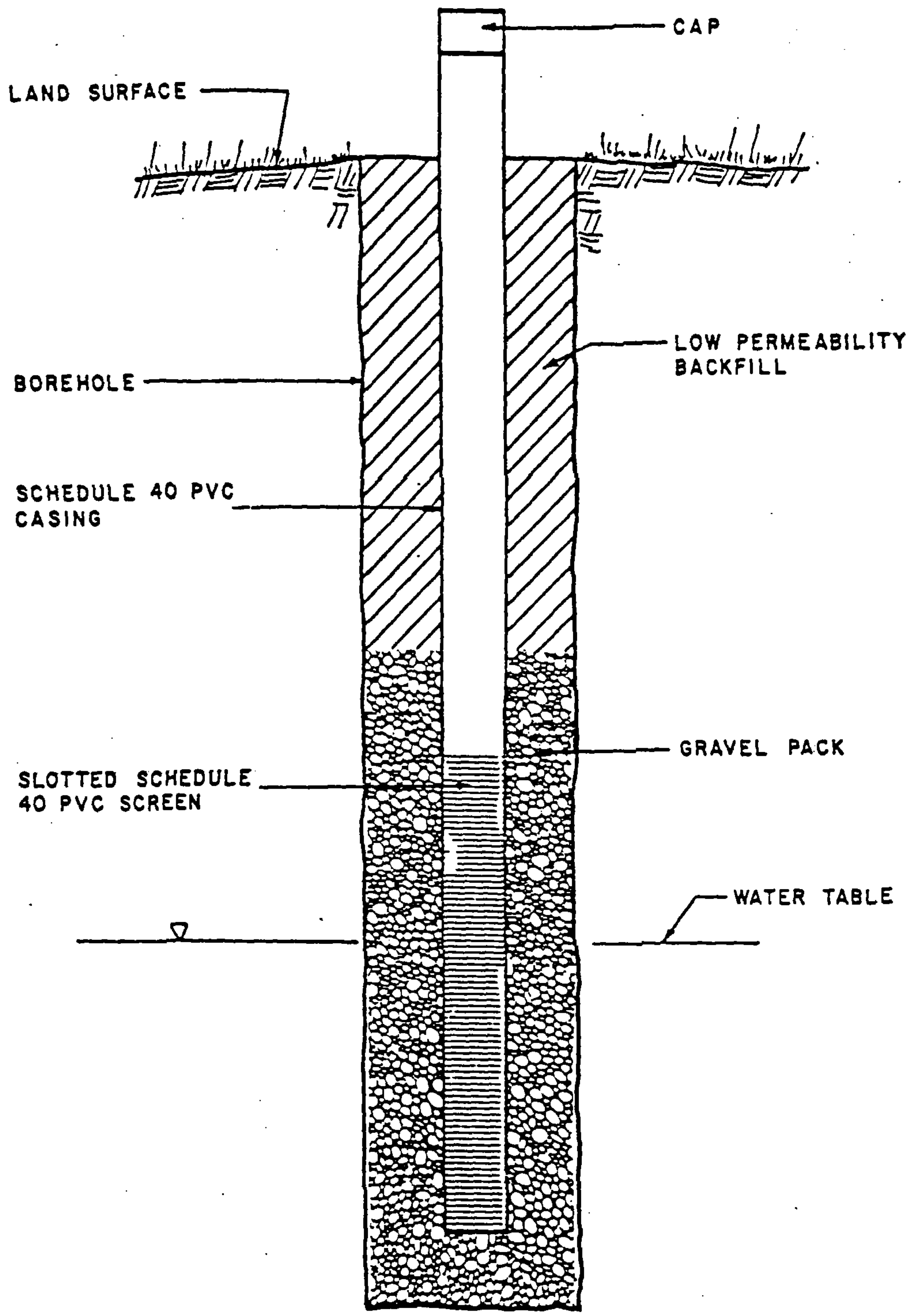
e) <u>Well Construction</u> - IEPA appears to be gauging regulatory acceptability on the basis of the checklist guidelines set forth in the draft groundwater TEGD. As recognized by the Science Advisory Board:

"More flexibility in the length of the well screen should be allowed. Well screen lengths should not be limited to a maximum of 10 feet, at least for detection monitoring. The objective of monitoring is to search for pollutants. If pollutants are discovered, then installation of depth-specific assessment monitoring wells and screens is appropriate. Aquifers commonly have zones of higher hydraulic conductivity which produce a large percentage of water to the well; these permeable zones will generally be the zones of dissolved contaminant transport which will be effectively sampled by long screens with minimal dilution. Sinkers and floaters can be detected by thief sampling much more economically than by well clusters." (SAB, p. 15-16)

Additionally, it must be recalled that monitoring wells at UNOCAL's land treatment facility began being installed in June of 1979. At that time, the well construction actually exceeded the United States Environmental Protection Agency guidelines contained in SW-611-Procedures Manual for Ground Water Monitoring at Solid Waste Disposal Facilities. This is shown by Figure 1 which illustrates a "typical monitoring well" taken from the U.S.E.P.A. December 1980 publication. Furthermore, the location and design of the monitoring wells installed in March of 1984 were reviewed and subsequently approved by the IEPA prior to their installation. If the well installations which were once "state-of-the-art" and/or approved are now unacceptable, what assurances can the agencies provide to UNOCAL that a newly installed and

FIGURE 1

TYPICAL MONITORING WELL SCREENED
OVER A SINGLE VERTICAL INTERVAL



(Taken from USEPA - Procedures Manual for Ground Water Monitoring of Solid Waste Disposal Facilities - SW-611, Dec. 1980) approved monitoring network will not also be found to be deficient in the future? This is particularly true in the context that wells installed 5-10 years from today will probably be of improved design, relative to today's guidelines. Therefore, by inference wells installed by today's standards will be unacceptable 5-10 years from now. This is unrealistic since it indicates acceptance on the basis of a design standard and that is not the intent of the regulations.

The problem being faced is simply that over the past years, there have been improvements in the design and installation techniques for monitoring wells. However, the simple fact that a technique or method is improved does not imply that past method(s) are no longer adequate to fulfill the stated objective. If this were the case, all houses which didn't utilize maximum energy efficient design should be torn down. Obviously, this is absurd since many non-energy efficient houses fulfill the objective of providing shelter. In the case of the UNOCAL land treatment facility, the stated objective is to monitor the uppermost aquifer which at the Chicago Refinery coincides with the top of the water table.

Therefore, the question should be, do UNOCAL's monitoring wells achieve the required objectives? The regulations simply require the following:

- Monitoring wells provide representative groundwater samples of the uppermost aquifer.

- Monitoring wells insure "immediate" detection of the onset of contamination in the uppermost aquifer.

- Monitoring wells be cased in a manner that maintains borehole integrity; the casing is screened or perforated and packed with suitable material to enable sample collection; and that the annular space above the sampling depth be sealed with a suitable material to prevent sample and/or groundwater contamination.

It is UNOCAL's opinion that the existing monitoring system fulfills the above requirements, and this opinion is supported by the following:

- Based on the site characterization contained in Attachment 1, the uppermost aquifer generally coincides with the top of the water table, and as shown in Appendix A to Attachment 1, the range of water table fluctuation (plotted on the left of the well construction diagrams) is contained within the slotted portion of the well screen, except for monitoring well MW-5. In MW-5, the water level observed during drilling appeared lower than expected, and it was believed that the hydraulic gradient was steepening because of the closer proximity of MW-5 to the upland hillside. However, after the well was installed, the water level slowly rose to an elevation above the well screen but within the sand pack. Therefore, in all the wells but one, the well screen is intersected by the top of the water table, and in MW-5 the well screen is in direct hydraulic communication with the well screen via the sand pack. As a consequence, the existing wells collect representative groundwater samples from the top of the water table which in turn coincides with the uppermost aquifer(s).

- As stated above by the SAB, the length of the well screen, within reason, is relatively unimportant when monitoring the top of the water table. We agree that the length of the well screen is important if a discrete zone <u>within</u> the aquifer is to be monitored, and in fact many USEPA regions are specifying five foot well screens rather than ten foot well screens in these instances. As a point of fact, the optimum well screen length at the UNOCAL facility is probably 15 feet. This is because a 15 foot well screen would allow water table fluctuations to be contained within the screened portion, while at the same time accommodating an adequate depth of water within the well to facilitate sampling. However, 10 or 20 foot well screens will also provide perfectly acceptable results.

- The "excessive" length of the sand pack simply reflects old vs. new well installation techniques. However, since the vast majority of the sand pack is above the water table and the annular space above the sand pack and between the well casing and borehole are adequately sealed (see below), its significance is probably of moot concern. If the above conditions did not exist, there could be concern for potential contaminant migration through the annular space. This occurrence could contaminate not only the groundwater sample but also the groundwater in general. Based on monitoring results over the past seven years, and as discussed below, this condition does not exist.

- Concerning the sealing of the annular space between the well casing and the borehole, the IEPA pre-enforcement conference letter states "i.e., cement grout or bentonite slurry". The abbreviation i.e. means "that is" which implies either cement grout or bentonite slurry is required. The regulations actually state "e.g., cement grout or bentonite slurry". The abbreviation e.g. means "for example" and implies no specificity to the material other than being of suitably low permeability. Additionally, the USEPA, December 1980 publication SW-611 recommends low permeability backfill (see Figure 1). Inspection of Table 4 in Attachment 1 shows that the media calculated permeability of the native clay backfill is approximately 2 x 10^{-7} cm/sec. This is considered a low permeability. Additionally, excluding the surficial cement plug and bentonite seal over the sand pack, there is a minimum of 30 feet of low permeability clay backfill which protects the groundwater sample and groundwater from surficial contamination.

Considering that the monitoring wells are located immediately adjacent to and in some cases within the land treatment facility, and that since the inception of monitoring in 1979 have shown no evidence of contamination is believed to be adequate evidence that the annular space above the sampling depth is sealed with a suitable material to prevent the contamination of samples and/or the groundwater.

- Probably, the most convincing demonstration of the suitability of the monitoring well construction is obtained by inspection of the analytical results obtained from the wells (see Part B permit application and Groundwater Assessment Reports). Inspection of the groundwater quality data which has been routinely monitored since 1979, shows a consistency of water quality results which could not have been achieved by wells whose construction was deficient. Therefore, on the basis of past performance, the wells have been demonstrated to be suitable for groundwater monitoring.

On the basis of the above, it is UNOCAL's position that the existing monitoring wells are constructed in a manner that complies with the regulations and provide representative samples of the uppermost aquifer.

ATTACHMENT 1

UNOCAL LAND TREATMENT FACILITY

CHARACTERIZATION OF HYDROGEOLOGIC ENVIRONMENT

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LIST OF FIGURES (Continued)

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CHARACTERIZATION OF HYDROGEOLOGIC ENVIRONMENT AND DETECTION MONITORING PROGRAM

1.0 GENERAL DESCRIPTION OF MONITORING SYSTEM

As shown on Figure 1 (in packet), the monitoring system for the Chicago Refinery land treatment facility utilizes a variety of methods to detect potential contaminant migration into the ground water. The system consists of lysimeters, near surface soil core samples, and monitoring wells into the perched water to monitor the unsaturated zone and provide early detection of potential contaminant migration. Additionally, in the saturated zone, a number of ground water monitoring wells have been installed to monitor the uppermost aquifer for signs of statistically significant contamination.

2.0 SITE CHARACTERISTICS

2.1 Topography

The Chicago Refinery land treatment site is located in the Wheaton morainal physiographic subdivision of Illinois. The topography of the area is characterized by hilly terrain, broad parallel morainic ridges, lakes, and swamps. Maximum topographic relief between the land treatment site and the Des Plaines River to the west is approximately 150 feet. Maximum relief at the land treatment site is approximately 50 feet (Figure 1).

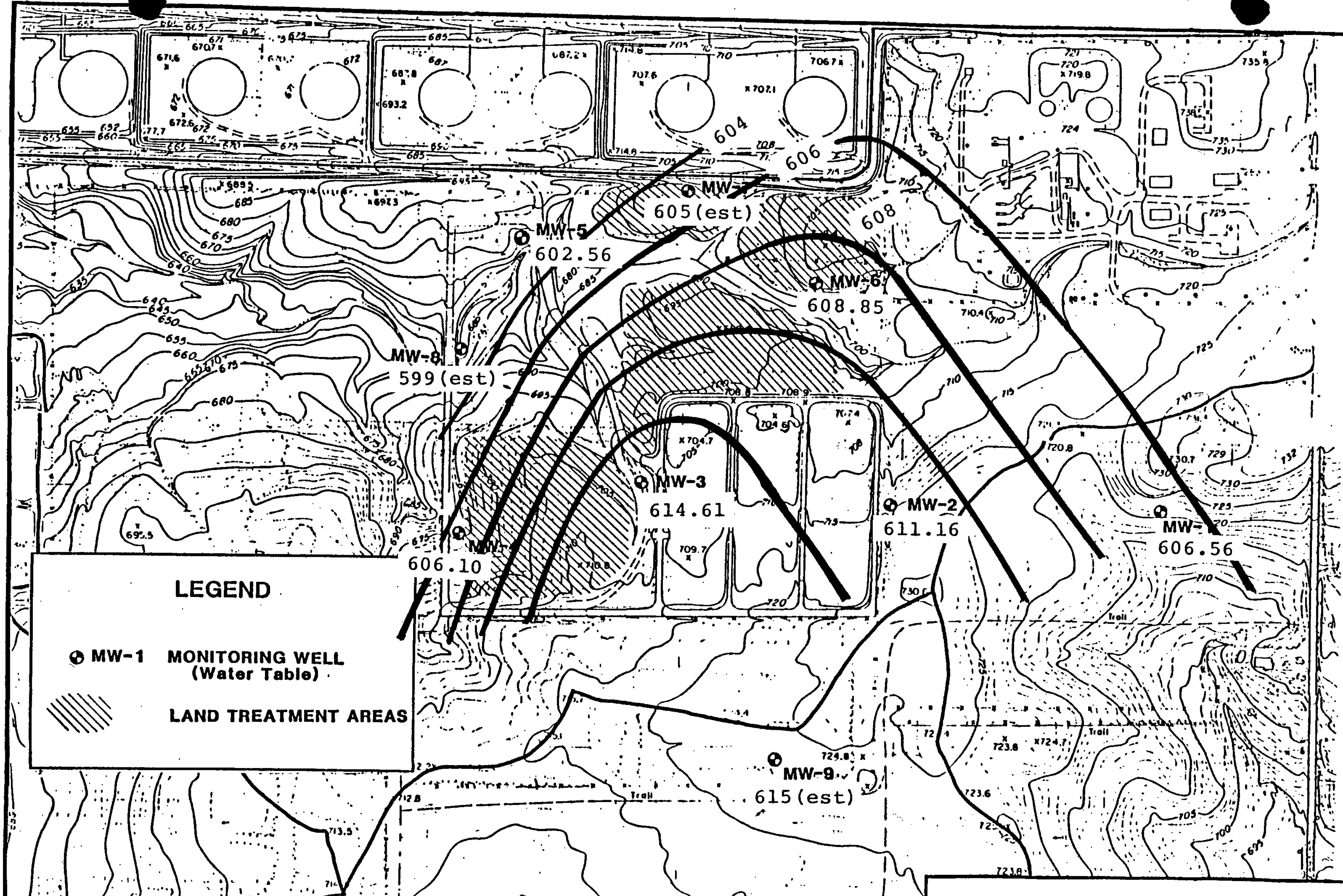
Additionally, based on the depth to bedrock encountered in the investigative borings, contours of the limestone bedrock surface appear to slope toward the northwest over the vast majority of the land treatment facility (see Figure 2).

The Chicago Sanitary and Ship Canal and the smaller Illinois and Michigan Canal are east of and parallel to the Des Plaines River. The Illinois and Michigan Canal borders the Chicago Refinery western property line, and is approximately one mile west of the land treatment area.

2.2 Geology

In the Lemont area, the region is underlain by sedimentary rocks (Table 1) which tend to be continuous over large areas and, include shales, sandstone, limestone, siltstone, dolomite and claystone. Although bedrock formations were deposited on essentially flat planes, the bedding planes presently dip at 10-15 feet per mile to the east. Within the area, the bedrock surface consists of Silurian Niagaran dolomite. Since the preglacial topography was varied from gently sloping to rugged, the depth of bedrock can change abruptly over short distances (Hughes, Kraatz and Landon, 1966). Glacial drift now fills many of the deep valleys which were eroded in the bedrock prior to and during glaciation, and excluding portions of the river valley, the bedrock is generally mantled with varying thicknesses of glacial till.

In the Silurian Niagaran Series (Table 1), bedrock tends to be a very fine crystalline, relatively pure to argillaceous, compact to porous dolomite with some dolomitic siltstone (Hughes, et al, 1966). The upper portion of the Niagaran Series system is characterized by reefs of pure dolomite surrounded by impure cherty



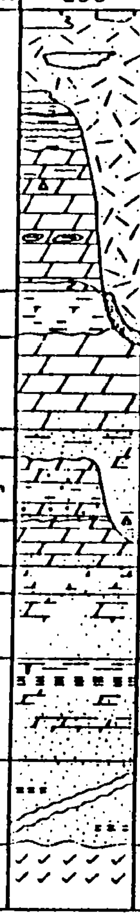
CHICAGO AERIAL SURVEY
2140 WOLF ROAD
DES PLAINES, ILLINOIS 60018
312.298.1480
Revised October 1976

T. M. GATES INC.

200 0 200 400 600 800 1000

DATE OF AERIAL PHOTOGRAPHS: 1/25/73 | C. A. S. PROJECT NUMBER: CO 9456
CAMERA FOCAL LENGTH: 88.54 mm. | CONTOUR INTERVAL: 1 FOOT

FIGURE 2
CONTOURS OF BEDROCK SURFACE

SYSTEM	SERIES	MEGA GROUP	GROUP OR FORMATION	GRAPHIC LOG	THICKNESS (FEET)	DESCRIPTION	AQUIFER SYSTEMS	
QUATERNARY	PLEISTOCENE				0 - 400 +	Unconsolidated ice- and water-laid deposits, pebbly clay (till), silt, sand and gravel, generally discontinuous and interbedded; alluvial silts and sands commonly present along streams.	Glacial drift aquifer system	Sand and gravel beds serve as aquifers. Some wells yield more than 1000 gpm. Large supplies of water available from thick, relatively continuous sand and gravel deposits.
PENNSYLVANIAN					0 - 175	Shale; sandstone, fine grained; limestone; coal; clay.	Shallow bedrock aquifer system	Fractured beds yield small supplies locally.
MISSISSIPPIAN* DEVONIAN								
SILURIAN	NIAGARAN				0 - 400 +	Dolomite, very pure to very silty, cherty; shale partings; thin shales and argillaceous beds frequently present in lower parts of Silurian dolomite.		Not consistent; some wells yield more than 1000 gpm. Crevices and solution channels more abundant near bedrock surface.
	ALEXANDRIAN				0 - 165			
ORDOVICIAN	CINCINNATIAN		Maquoketa		0 - 250 +	Upper and middle units—shale, light gray to green, plastic to brittle, some dolomite, silty; dolomite, mostly silty, argillaceous; minor limestone. Lower unit—shale, dark gray, black, brown, plastic to brittle; some dolomite in upper part; silty, argillaceous.		Yields water from fractured beds. Shales, particularly in lower unit, act as confining beds at the base of the shallow bedrock aquifer system.
	CHAMPLAINIAN	OTTAWA	Galena Platteville		150 - 350 +	Dolomite, cherty; sandy at base; limestone; shale partings.	Deep bedrock aquifer systems: Cambrian-Ordovician aquifer system	Where below shales, development and yields of crevices are small; where not capped by shales, dolomites are fairly permeable.
			Glenwood St. Peter		75 - 650	Sandstone, fine to coarse grained; shale at top; locally cherty red shale at base.		Glenwood-St. Peter Sandstone. Small to moderate quantities of water. T probably about 15% of that of Cambrian-Ordovician aquifer system.
	CANADIAN	KNOX	Prairie du Chien		0 - 340	Dolomite, sandy, cherty, interbedded with sandstone.		Crevices in dolomite and sandstone generally yield small amounts of water. Potosi dolomite locally well creviced and partly responsible for exceptionally high yields of several deep wells. T probably about 35% of that of Cambrian-Ordovician aquifer system.
CAMBRIAN	CROIXAN		Eminence Potosi		0 - 225	Dolomite, white, fine grained, sandy at base; drusy quartz.		
			Franconia		45 - 175	Sandstone, dolomite, and shale, glauconitic, green to red, micaceous.		
			Ironton Galesville		103 - 275	Sandstone, fine to medium grained, well sorted, upper part dolomitic.		Ironton-Galesville Sandstone. Most productive part of Cambrian-Ordovician aquifer system. T probably about 50% of entire system.
			Eau Claire		235 - 450	Shale and siltstone, dolomitic, glauconitic; sandstone, dolomitic, glauconitic; dolomite, sandy.		Shales generally not water yielding; act as confining bed at the base of the Cambrian-Ordovician aquifer system.
		POTSDAM	Mt. Simon		2000 +	Sandstone, coarse grained, white, red in lower half; lenses of shale and siltstone, red, micaceous.	Deep bedrock aquifer systems: Mt. Simon aquifer system	Mt. Simon Sandstone. Data sparse; probably less permeable than Ironton-Galesville; quality of water deteriorates with depth.
PRECAMBRIAN						Not penetrated by wells in Chicago area. Nearby wells encounter red or gray granite or similar rocks.		

*Mississippian rocks present in Des Plaines Disturbance. Devonian rocks present as crevice fillings in Silurian rocks.

Modified from Suter et al., 1959, p. 24; Zeizel et al., 1962, p. 14; Walton and Csallany, 1962, p. 9.

UNOCAL CORPORATION - LEMONT, ILLINOIS

CHICAGO REFINERY

TABLE 1

STRATIGRAPHY AND AQUIFER SYSTEMS

OF NORTHEASTERN ILLINOIS

* Taken from Hughes, Kraatz and Landon (1966)

dolomite (Willman, 1971). Underlying the Niagaran dolomite, the strata of the lower Alexandrian Series consists of an argillaceous limestone or dolomite overlain by more pure glaucanitic dolomite which is sometimes cherty (Willman, et al, 1975).

Underlying the Silurian System, the Ordovician Series consists of three series. The upper Cincinnati Series consists primarily of shales of the Maquoketa Group. The middle Champlainian Series is made up of limestone and sandstone of the Galena, Platteville, Glenwood and St. Peter Formations. The lower Canadian system consists of sandy, cherty dolomite interbedded with sandstone of the Prairie du Chien Formation. This formation is absent in northern Chicago, but thickens to about 300 feet in the southern part of the area.

In the vicinity of the Chicago Refinery, the Cambrian strata consist primarily of well rounded, poorly to well sorted sandstone (Willman, et al, 1975). The Ironton-Galesville aquifer which passes through the upper portion of this system, consists of dolomite, sandy dolomite, sandstone and siltstone. Eau Claire Shales act as an aquiclude and separate the Ironton-Galesville aquifer from the underlying coarse grained Mt. Simon Sandstone aquifer. The thickness of each of the bedrock strata varies widely through the northeastern Illinois area (Table 1).

The Chicago Refinery is located within the Wheaton Morainal County of the Great Lakes Section of the Central Lowlands Province (Willman, 1971). The surrounding area tends to be rugged and is an excellent example of topography produced by continental glaciers.

Specifically, the site is located on the West Chicago/-Wheaton Moraines of the Valparaiso Morainic System. This system was deposited during the Woodfordian substage of Wisconsin Age, and consist of nine closely spaced moraines which are in places undifferentiated within the area. The glacier appears to have advanced and retreated several times creating a rugged topography with knobs, kettles, swamps and lakes.

Although the terrain is rugged, surface drainage is quite poor and ponding is common. This results in large amounts of infiltration which is the principal source of ground water recharge for the shallow glacial till and Niagaran dolomite aquifers in the area.

The Des Plaines River formed a major sluiceway for glacial Lake Chicago. Prominent alluvial deposits found along the river are sand and gravel terrace deposits of the Mackinaw Member of the Henry Formation. These deposits are fairly well sorted, evenly bedded, and relatively uniform in grain size (Willman, 1971). Although glacial deposits up to 350 feet thick are found in northeastern Illinois, less than 110 feet of clayey or silty till overlie the bedrock surface at the Chicago Refinery. This is confirmed by on-site borings that indicate thickness of glacial drift ranging from a thin veneer adjacent to the Des Plaines River to approximately 100 feet in the upland areas on which the land treatment facility is situated.

As previously discussed, the land surface in the vicinity of the Chicago Refinery was initially deposited as a ground moraine. Most of the till in the morainal deposits is clay and silt, but some sandy tills are found in the area. After the last glacial retreat, the Des Plaines River cut a valley through the morainal deposits, and within the valley, the flood plain to the west of the land treatment facility deposits consist of stratified alluvial layers of sand, silt, clay and gravel. On the basis of the available literature and existing boring logs, it appears that the unconsolidated deposits of glacial till located in the land treatment area of the Chicago Refinery were not affected by erosional down cutting of the Des Plaines River.

Underlying the land treatment area at the Chicago Refinery, the site consists of surficial soils, glacial till and the underlying bedrock.

The surficial soils are composed of those soils near the earth's surface at depths which are usually less than 5 feet. They generally consist of clays, silts, sands, and organic matter. The surficial soils serve as a natural medium for the growth of vegetation and form the upper part of the soil profile. Soils information were drawn from materials provided by the U. S. Department of Agriculture, Soil Conservation Service (1979), field investigations, and laboratory analyses. The surficial soils of the land treatment area consist of soils found on flat to gently sloping upland glacial till plains. These soils are of intermediate fertility, have moderate crop yields, and vary from poorly to well drained. A summary of soil characteristics is shown in Table 2, and a brief description of each soil series is given below. It should be noted that the land treatment area has been extensively graded in order to minimize run-off, slopes and optimize the overall contouring of the area. As a consequence, the original surficial soils which are identified below and in Table 2 have been extensively mixed, relocated and/or otherwise altered. Therefore, published soil reports are of little value since they were prepared prior to grading, and Union Oil will have to implement a new soil survey of the area to characterize the surficial soils. This survey will be performed as part of the treatment demonstration, if that option is chosen.

<u>Blount Soil Series</u> - Blount soils generally are light-colored soils which developed in loess on silty clay loam material. The Blount soils are somewhat poorly drained and can be generally found under native forest vegetation. Blount soils are used for cropland and have a slow to moderately slow permeability. Generally, available moisture capacity is high, surface runoff is medium, and the surface organic matter content averages 2.5 percent.

<u>Morley Soil Series</u> - Morley soils consist of light-colored, moderately well to well-drained soils developed in loess on silty gray loam glacial till. Morley soils are predominantly in cropland with only occasional areas in timber and pasture. The soil permeability is moderately slow to slow with surface runoff being medium to rapid. The available moisture capacity is high, and the organic matter content averages 2.5 per cent. Morley soils are associated with the somewhat poorly drained Blount soils where they occur.

<u>Ashkum Soil Series</u> - Ashkum soils appear very dark in color and develop in silty to loamy material over silty clay loam glacial till. Ashkum soils are found on

TABLE 2

GENERAL CHARACTERISTICS FOR SOILS TYPICAL OF THOSE OCCURRING AT THE CHICAGO REFINERY - LAND TREATMENT FACILITY

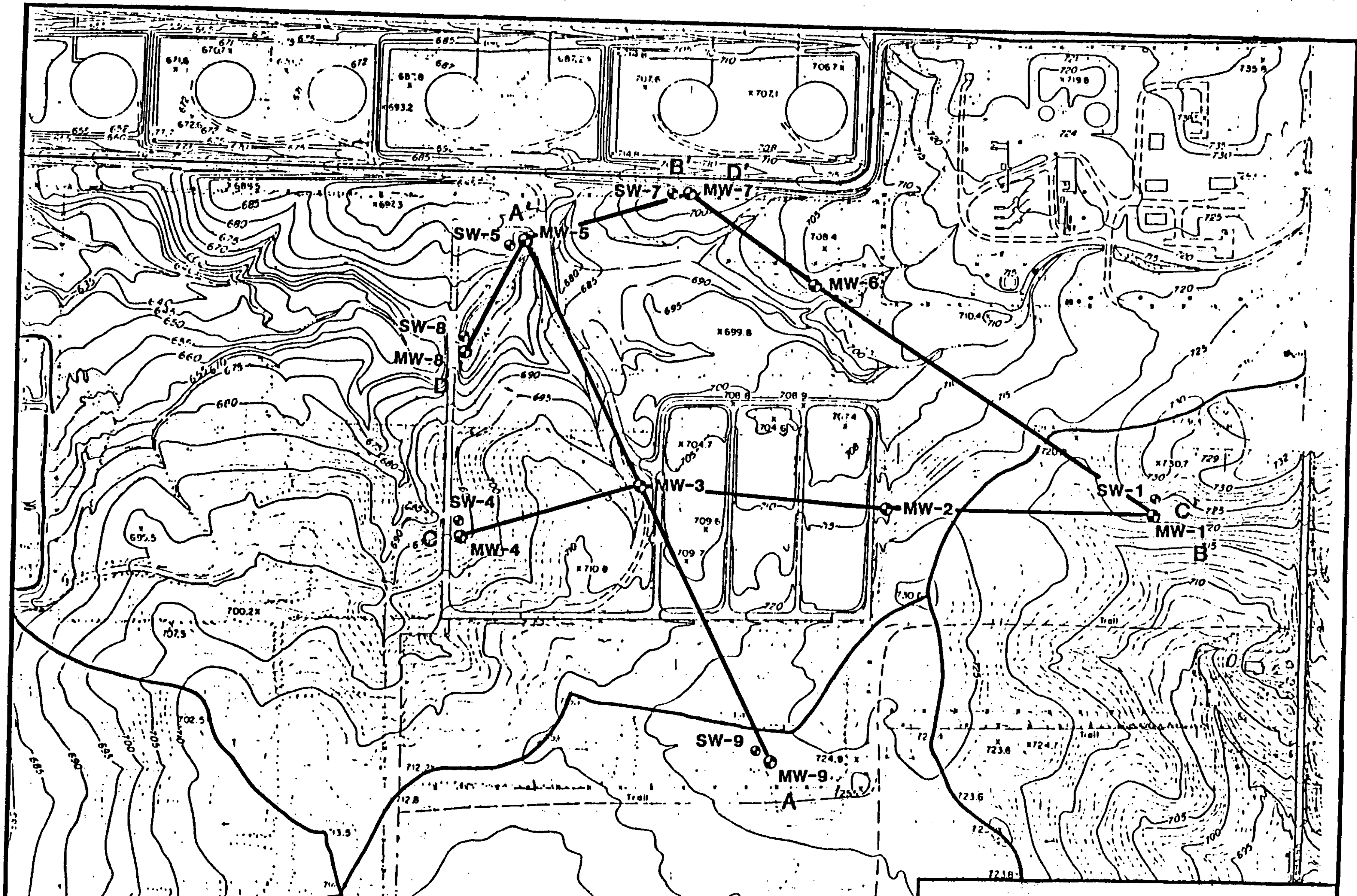
Soil Series	Percent of Site Area	Soil Order	Soil Profile Depth (inches)	USDA Texture	Unified Soil Classification	Depth to Parent Material (inches)	Depth to Seasonally High Water Table (inches)	Permeability in/hr (cm/sec)	Drainage	Shrink/Swell Potential	Natural Fertility	Parent Material	Erosion Hazard	Potential Limitations
Blount	27	Aeric Ochraqualfs	0-10 10-32 32-60	Silt loam, loam Silty clay loam, silty clay Silty clay loam, clay loam	ML, CL CH, CL CL	>60	12-36	$4.23x10^{-4}$-$1.41x10^{-3}$ $4.23x10^{-5}$-$4.23x10^{-4}$ " "	Poorly drained	Low Moderate Moderate	High	Glacial till	Slight	Frost action high Perched water table, Jan-May Thin topsoil layers
Morley	49	Typic Hapludalfs	0- 9 9-19 19-28 28-60	Silt loam, silty clay loam Silty clay loam, clay loam Silty clay, clay loam, clay Silty clay loam, clay loam	CL, CL-ML CL CL, CH CL	>60	36-72	$1.41x10^{-4}$-$1.41x10^{-3}$ $1.41x10^{-4}$-$4.23x10^{-4}$ $4.23x10^{-5}$-$1.41x10^{-3}$ $1.41x10^{-4}$-$4.23x10^{-4}$	Moderately well to well drained	Low-moderate Moderate Moderate Moderate	High	Glacial till	Slight to to moderate	Erodes easily Percolates slowly Perched water table Mar-May
Ashkum	13	Typic Haplaquolls	0-14 14-44 44-60	Silty clay loam Silty clay loam Silty clay loam	CL, CH CL CL	>60	<24	$4.23x10^{-4}$-$1.41x10^{-3}$ $1.41x10^{-4}$-$4.23x10^{-4}$ " "	Poorly drained	Moderate Moderate to high Moderate	Moderate	Glacial till	Slight	Poorly drained Seasonal high water table Slow permeability
Chatsworth	11	Typic Eutrochrepts	0- 5 5-60	Silty loam, silty clay loam Silty clay, clay, silty clay loam	CL, CH CL, CH	>60	36-72	$4.23x10^{-5}$-$1.41x10^{-3}$ $4.23x10^{-5}$	Moderately well drained	Low-moderate Moderate	Moderate	Glacial till and alluvial deposits	Slight	Perched water table Nov-May Percolates slowly

Source: Personal communication Mr. Al May, U.S.D.A. Soil Conservation Service, Lemont, Illinois, 6/5/79.

nearly level areas and are almost entirely found in cropland with moderately slow permeability. Surface runoff is slow and the available moisture capacity is high to very high. Organic matter content at the surface generally averages about 6.0 percent.

<u>Chatsworth Soil Series</u> - Moderately well to well drained, Chatsworth soils are light in color and generally developed from loess material over silty clay and clay glacial till. They occur primarily on sloping upland till plains on slopes associated with moderately well drained Morley soils in silty clay loam till areas. Permeability of the Chatsworth soils is very slow with runoff being rapid to very rapid. Available moisture capacity is low to moderate, and the surface organic matter content averages 2.0 percent.

The site subsurface geology was defined by investigative borings and a review of the available literature. Using the boring logs/well construction diagrams presented in Appendix A, four geologic cross-sections through the land treatment area were developed. The locations of the geologic cross-sections are shown on Figure 3 and cross-section A-A', B-B', C-C' and D-D' are shown on Figure 4, 5, 6, and 7, respectively. An inspection of these figures reveal that the vast majority of glacial material overlying the limestone bedrock is glacial till consisting of low permeability clayey silts and silty clays. The thickness of the till ranges from approximately 110 feet in the southern and eastern portions of the land treatment area to approximately 40-50 feet in the northern and western portions of the site where the land surface begins to slope toward the river. The next most prominent soil type is a clayey, silty, fine to



UNOCAL
CHICAGO REFINERY

T. M. GATES INC.

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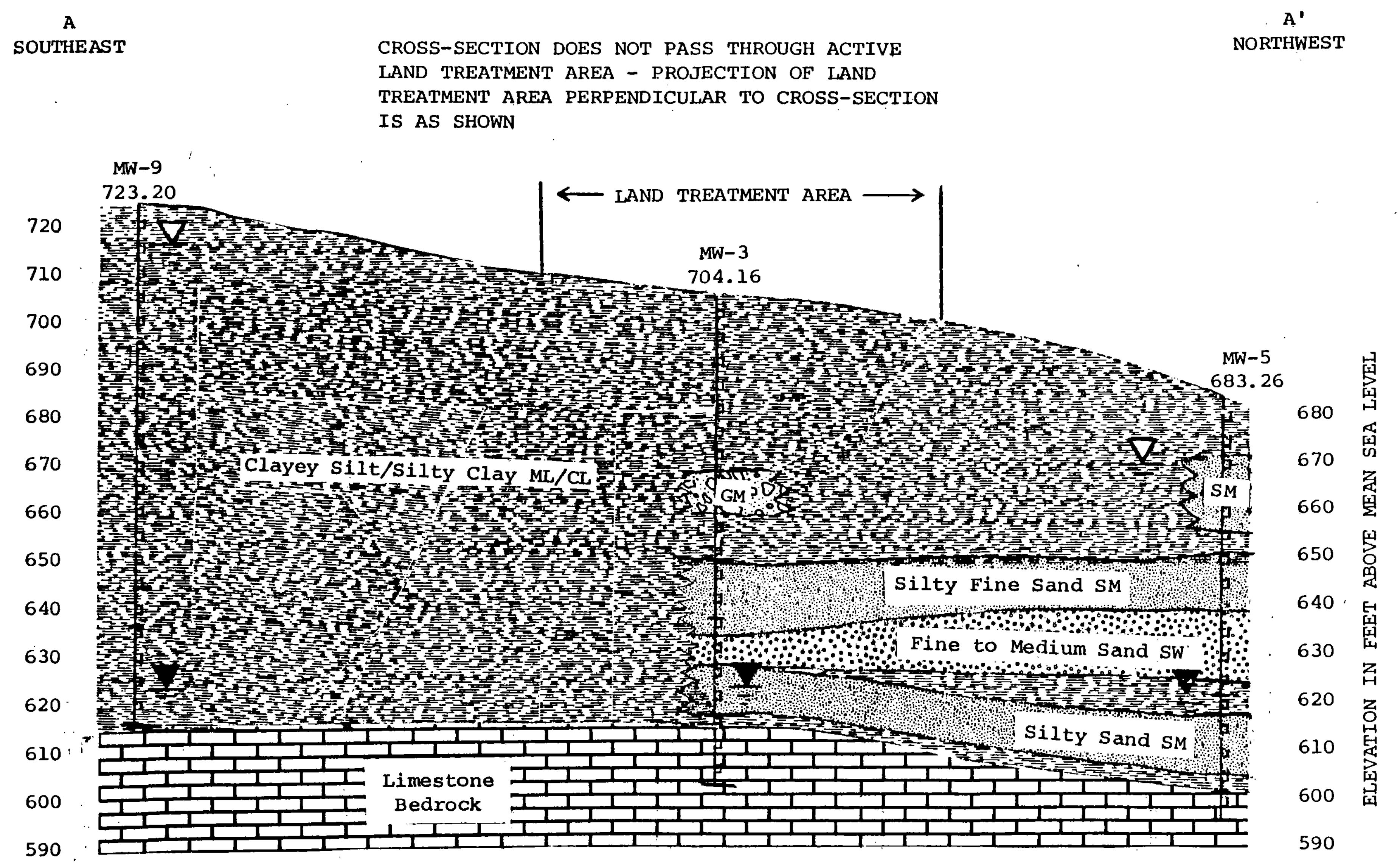
DATE OF AERIAL PHOTOGRAPHS: 1/25/73 | C. A. B. PROJECT NUMBER: CO 9466

FIGURE 3

LOCATION OF GEOLOGIC CROSS-SECTIONS



LEGEND	SCALE	UNOCAL CORPORATION - LEMONT, ILLINOIS
▽ PERCHED WATER	HORIZONTAL 1" = 250'	FIGURE 4
▼ WATER TABLE	VERTICAL 1" = 30'	GENERALIZED GEOLOGIC CROSS-SECTION A-A'
	(Revised 3/01/85)	THROUGH LAND TREATMENT AREA

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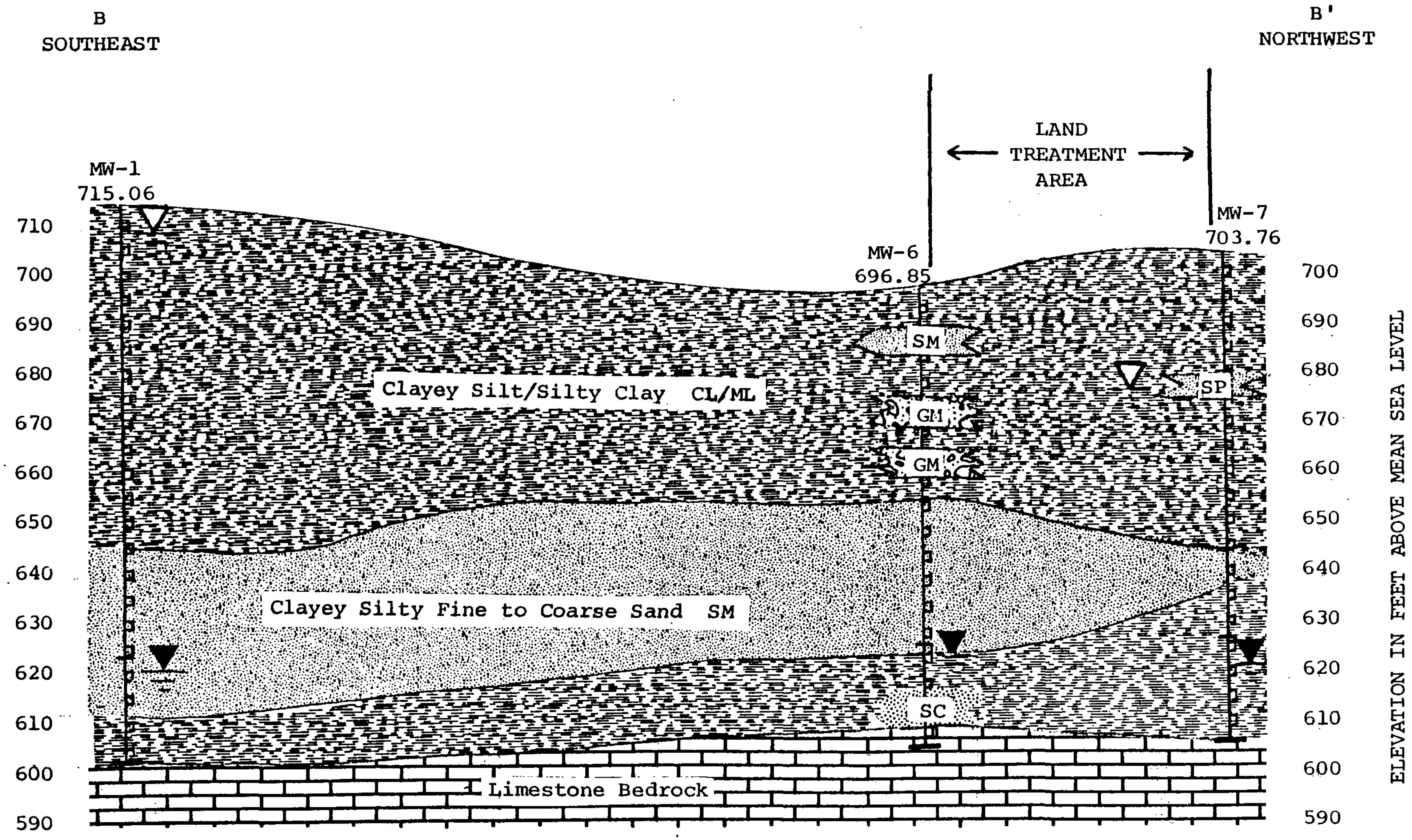

LEGEND	SCALE	
▽ PERCHED WATER ▼ WATER TABLE	HORIZONTAL 1" = 250' VERTICAL 1" = 30' (Revised 3/01/85)	UNOCAL CORPORATION - LEMONT, ILLINOIS FIGURE 5 GENERALIZED GEOLOGIC CROSS-SECTION B-B' THROUGH LAND TREATMENT AREA

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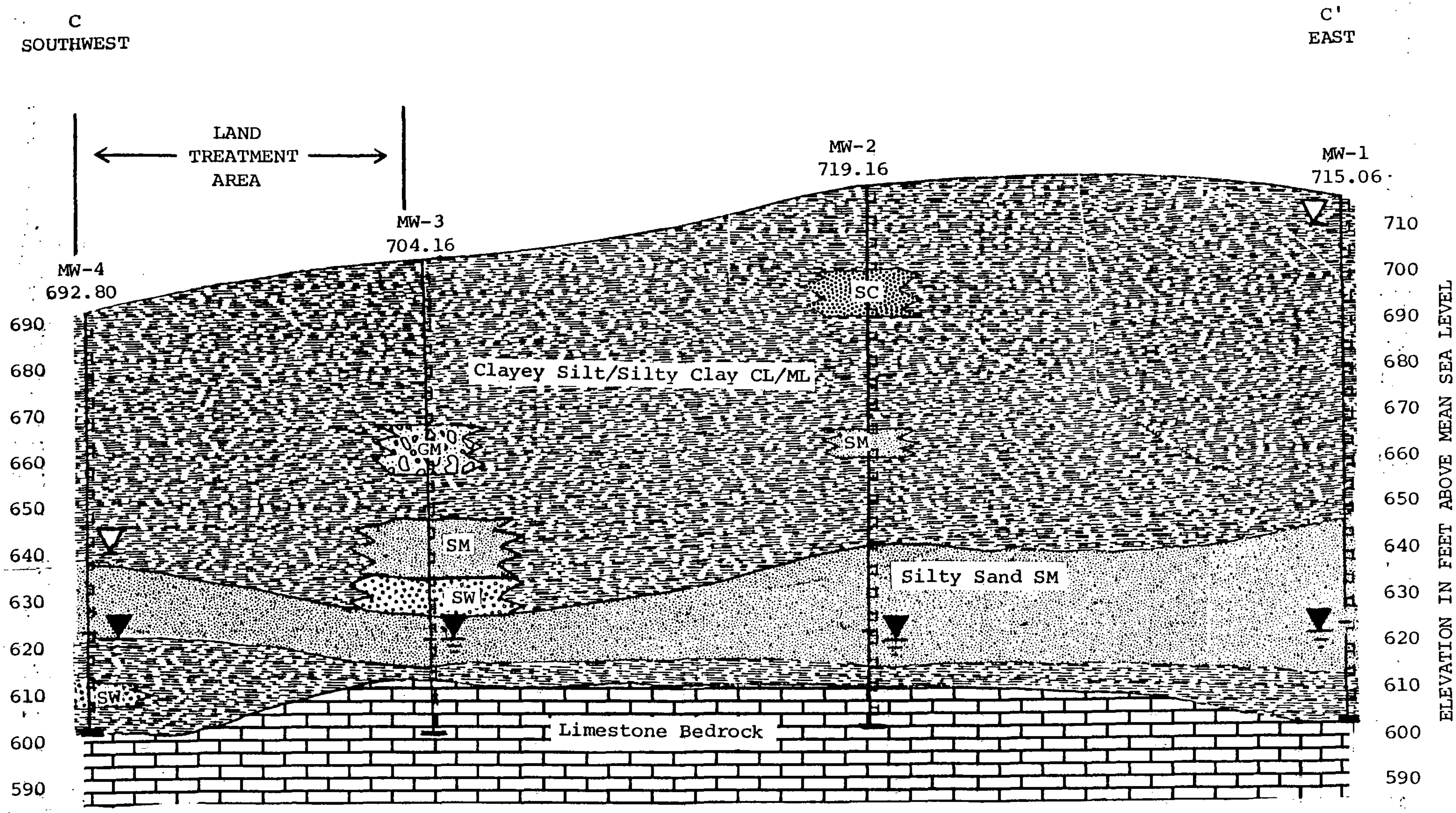

LEGEND

▽ PERCHED WATER

▼ WATER TABLE

SCALE

HORIZONTAL 1" = 250'

VERTICAL 1" = 30'

(Revised 3/01/85)

UNOCAL CORPORATION - LEMONT, ILLINOIS

FIGURE 6

GENERALIZED GEOLOGIC CROSS-SECTION C-C'

THROUGH LAND TREATMENT AREA

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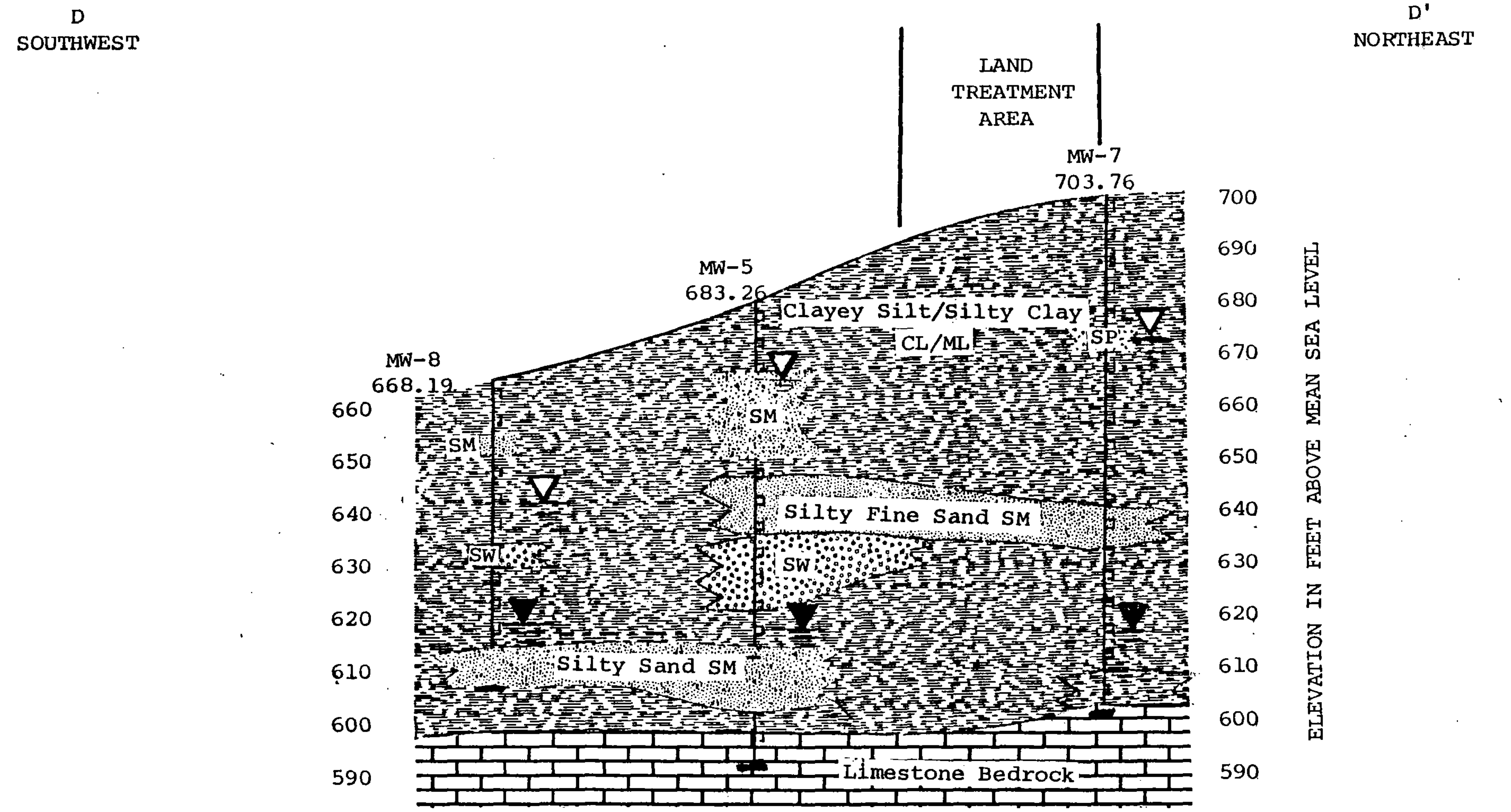

LEGEND

▽ PERCHED WATER

▼ WATER TABLE

SCALE

HORIZONTAL 1" = 250'

VERTICAL 1" = 30'

(Revised 3/01/85)

UNOCAL CORPORATION - LEMONT, ILLINOIS

FIGURE 7

GENERALIZED GEOLOGIC CROSS-SECTION D-D' THROUGH LAND TREATMENT AREA

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coarse sand. This layer may vary from a few feet in thickness to approximately 30 feet thick. It generally occurs within 20 feet of the bedrock/soil interface. Although its horizontal continuity may exceed 2,000 feet, it is known to be absent under certain portions of land surrounding the land treatment area. Additionally, numerous zones consisting of discontinuous lenses/layers of clayey, silty sand and/or gravel were found to occur randomly throughout the subsurface geologic environment underlying the land treatment area. These zones were found to vary in thickness from a few inches to approximately 20 feet.

Underlying the glacial materials is the bedrock limestone (actually Niagaran Dolomite of Silurian Age) whose eroded surface under the land treatment area is slightly sloping toward the Des Plaines River (northwest)(Figure 2).

2.3 Hydrogeology

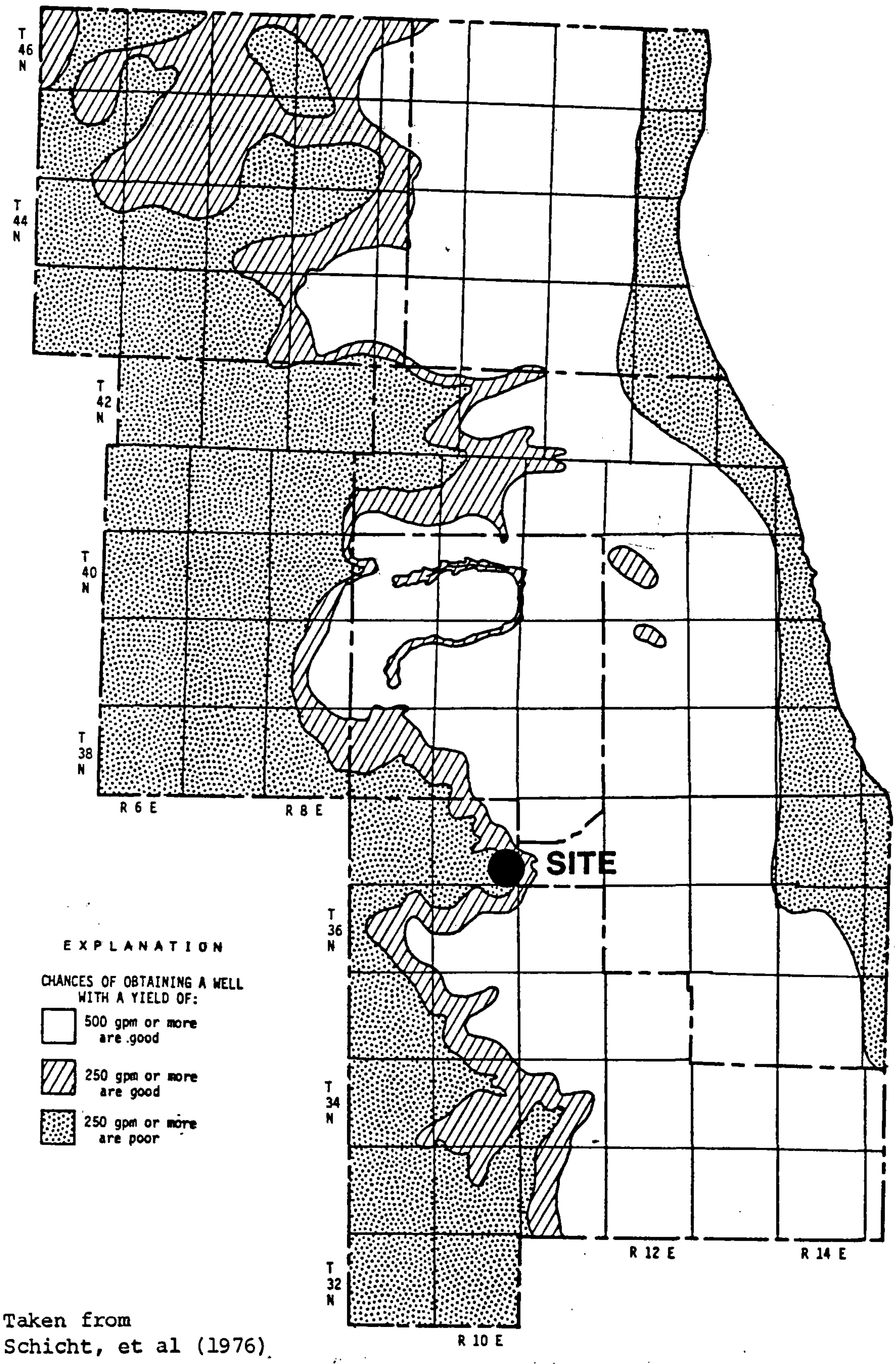
2.3.1 Regional Hydrogeology - With the exception of the Maquoketa shale, all glacial and bedrock formations in the vicinity of the Chicago Refinery have the potential of yielding water (Anderson, 1919). There are however, four designated aquifers within the region surrounding and underlying UNOCAL's land treatment facility (Table 1). Unconsolidated sand and gravel deposits in alluvium and glacial drift, and the fractured Silurian Niagaran Dolomites, comprise two separate but interconnected aquifers. These are the uppermost aquifers and underlie the entire land treatment facility (Figure 8). A third designated aquifer is the Cambrian-Ordovician Aquifer system. This system, is made up of limestones and

SW-5
A
MW-5
SW-7
B
D
MW-7
SW-8
MW-8
MW-6
SW-4
C
MW-3
MW-4
MW-2
SW-1
C
MW-1
B
SW-9
MW-9
A
CROSS HATCHED AREA SHOWS LOCATION OF UPPERMOST AQUIFER
UNOCAL
HICAGO REFINERY
TREATMENT AREA
T. M. GATES INC.
200 0 200 400 600 800 1000
DATE OF AERIAL PHOTOGRAPHS: 1/25/73
CAMERA FOCAL LENGTH:
CONTOUR INTERVAL
FIGURE 8
AERIAL

sandstones below the Maquoketa shale and the principal water bearing formations are the Glenwood-St. Peter sandstone and the Ironton-Galesville sandstone. The fourth designated aquifer, the Mt. Simon sandstone, is separated from the overlying sandstone aquifers by the impermeable Eau Claire shales. The third and fourth aquifer systems although not interconnected are commonly referred to jointly as the "deep sandstone aquifers" (Table 1).

Generally, water can be found in the glacial deposits just above the bedrock surface. In the vicinity of the Chicago Refinery, recharge to the glacial deposits is by direct infiltration of precipitation and ground water movements from the upland areas. Artesian conditions are sometimes present, when clay beds act as confining layers. Although it is likely that some glacial ground water supplies exist in the vicinity, their shallow nature in the Des Plaines River valley is expected to greatly limit their potential. The importance of the glacial deposits is not their ability to provide ground water, but the fact that they act as the principal source of recharge to underlying shallow dolomite aquifer.

The productivity of the shallow Niagaran system is greatest where there are fractures and solution cavities, formation is thickest, and there are no impermeable layers between the dolomite and the glacial deposits. Although the land application area is mantled by a thick blanket of low permeability till, the Chicago Refinery appears to be located adjacent to a favorable area for development of ground water resource from the dolomite aquifer (Figure 9). This results from the fact



* Taken from
Schicht, et al (1976)

UNOCAL CORPORATION - LEMONT, ILLINOIS

CHICAGO REFINERY

FIGURE 9

ESTIMATED YIELDS OF SHALLOW DOLOMITE WELLS that the adjacent area contains thick dolomitic layers which are known to be hydraulically connected to the overlying glacial deposits.

Approximately 40% of the ground water pumped near the Chicago Refinery is derived from the deep sandstone formations (Schicht, et al, 1976 and Sasman, 1965). The most productive units of the Cambrian-Ordovician aquifer system are the Glenwood-St. Peter sandstone and the Ironton-Galesville sandstone. The deepest sandstone aquifer which is hydraulically isolated from the upper sandstone aquifer is the Mt. Simon sandstone. Although the deepest sandstone aquifer is very productive, only the top 200 feet are used because mineral contents become too great with depth. The principal area of recharge for both these aquifers system is in south central Wisconsin where, the beds dip gently to the south and east and produce artesian conditions in the Chicago area. It should be noted that although the deep sandstone aquifers are recharged in the same general area where they outcrop at the surface, they are hydraulically isolated from one another by the Eau Claire shale and from the overlying Niagaran dolomite aquifer and interconnected glacial aquifer by the Maquoketa shale. Additionally, the naturally occurring artesian conditions occurring in the deep sandstone aquifers results in an upward vertical flow component which further acts to inhibit the potential downward migration of contaminants. As a consequence, the only aquifer(s) of concern is the uppermost aquifer which consists of discontinuous glacial sands and gravels which overly and are interconnected with the Niagaran dolomite aquifer.

2.3.2 Site Hydrogeology - Based on field observations and the water level data presented in Table 3, the shallow ground water environment at the land treatment site was found to have perched water in the unsaturated zone. In the saturated zone, ground water exists in both confined and unconfined conditions.

It appears that the occurrence of perched water is a function of discontinuous moderate and low permeability subsurface soil layers. The perched water occurs not as a continuous shallow zone, but rather as discontinuous lenses which are randomly distributed over the site, with respect to their horizontal and vertical locations. Therefore, the water quality results obtained from the shallow wells installed in the perched water will represent samples taken from a heterogeneous ground water environment. As a consequence, groundwater quality monitoring results from the shallow wells (perched water) will be evaluated individually and assessed in relation to observed water quality trends. This approach will be used instead of the Student's t-Test because of the absence of representative baseline/background water quality data which would be necessary to utilize the Student's t-Test method.

In the saturated zone below the water table, the ground water was found to be in both confined and unconfined (i.e., water table) conditions. In general, unconfined water table conditions exist when ground water was first encountered in the discontinuous clayey, silty fine to coarse sand layer that occurs near the bedrock/soil interface. In these cases the uppermost aquifer is considered to be the fine to coarse glacial sand.

UNOCAL CORPORATION - CHICAGO REFINERY

TABLE 3

SUMMARY OF GROUNDWATER ELEVATIONS (MSL)

DATE	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9
TOP OF CASINGS ELEVATIONS(1)	717.65	(2)	706.49	694.43	685.50	698.20	706.18	670.80	725.60
5/16/81	625.16	624.09	623.49	622.93	621.33	623.20	—	—	—
9/23/81	622.91	619.09	622.49	622.43	622.00	622.45	—	—	—
12/08/81	622.91	621.59	622.49	622.43	620.50	623.20	—	—	—
3/30/82	623.41	623.09	624.49	624.10	622.00	623.95	—	—	—
10/20/82	622.24	621.59	621.57	622.43	621.08	618.20	—	—	—
3/15/83	622.91	623.09	622.49	623.43	615.00	623.20	—	—	—
6/22/83	624.41	624.59	624.30	624.60	622.50	621.70	—	—	—
9/12/83	623.16	623.59	623.49	624.43	621.50	623.37	—	—	—
11/07/83	622.99	623.17	623.41	623.26	621.50	623.45	—	—	—
3/06/84	623.83	624.00	623.91	623.68	621.83	623.95	—	—	—
6/18/84	624.03	623.78	624.41	624.40	622.62	624.43	623.00	624.05	624.28
9/13/84	621.98	620.78	622.93	622.95	621.19	623.22	620.71	622.37	622.87
11/28/84	622.37	622.42	622.74	622.77	620.92	622.92	620.70	622.15	620.57
3/04/85	—	—	—	—	—	—	622.85	623.41	623.20
6/03/85	623.02	623.42	623.34	623.24	621.64	623.30	622.15	622.84	622.90
11/13/85	622.23	—	622.81	622.53	620.71	622.83	621.73	621.98	621.96

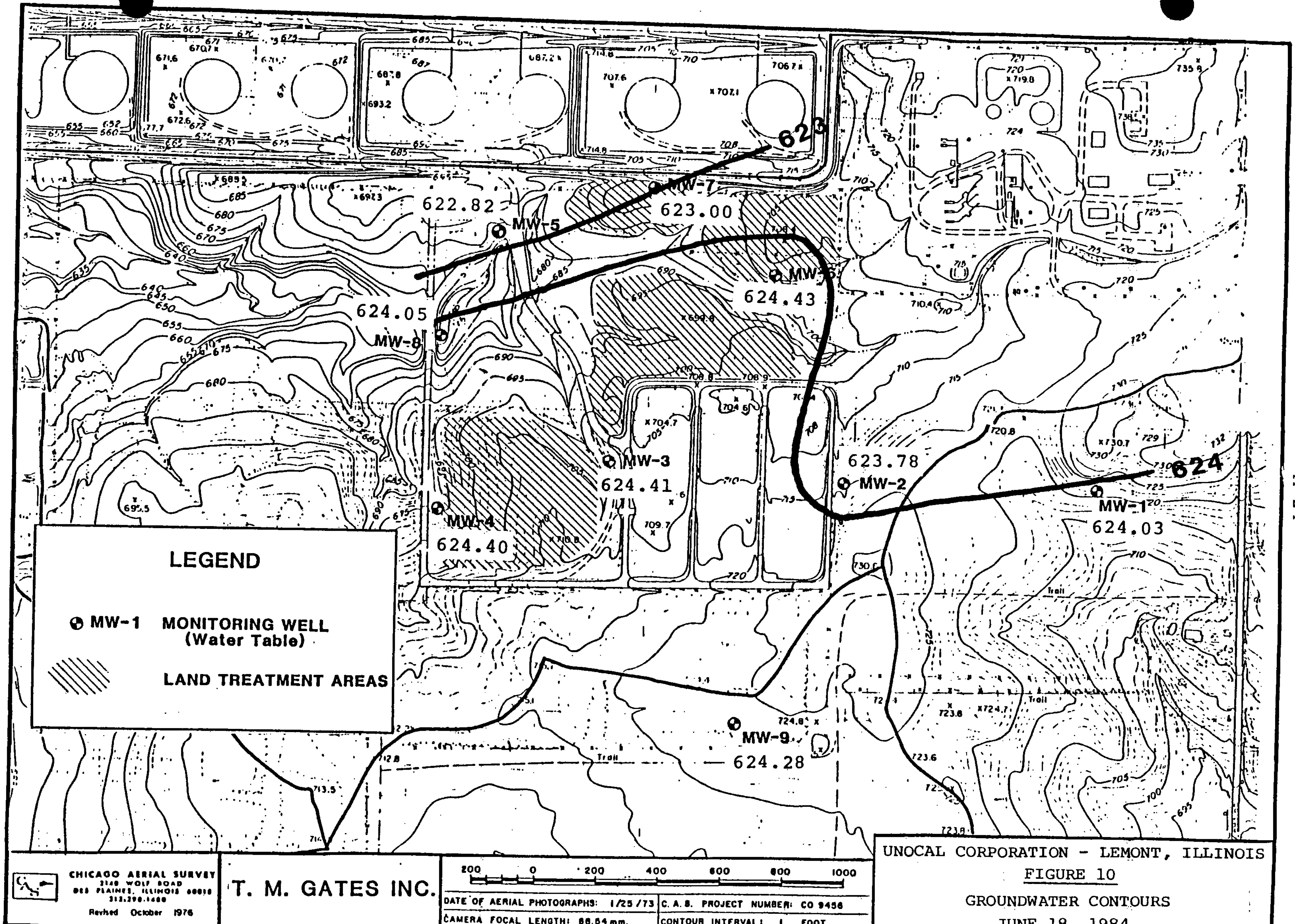
NOTES: (1) Resurveyed November 85
(2) Well being repaired

Confined ground water which typically rose 5-15 feet in the well was generally encountered when the clayey, silty fine to coarse sand layer was absent. In those instances, low permeability silty clay or clayey silt occupied the saturated zone overlying the limestone aquifer. These materials act as an aquiclude, and when penetrated, the static water levels rose to the elevations shown on Figures 4, 5, 6 and 7. In these cases where the silty clay or clayey silt aquiclude overlies the limestone, the uppermost aquifer is considered to be the Niagaran dolomite.

Using the water level measurements (Table 3) for the saturated zone, Figure 10, 11, 12, 13 and 14 were prepared showing the ground water contours underlying the land treatment areas. Based upon water level measurements and the groundwater contours shown on Figures 10 through 14, the net flow of groundwater in the site vicinity is to the northwest. The maximum hydraulic gradient calculated from the groundwater contours for each sampling period is presented below:

DATE OF MEASUREMENT	HYDRAULIC GRADIENT	REFER TO FIGURE #
6-18-84	0.0050	10
9-13-84	0.0087	11
11-28-84	0.0077	12
6-03-85	0.0043	13
11-13-85	0.0043	14

Based on the above, the average hydraulic gradient in the vicinity of the land treatment area was calculated to be 0.006. Similarly, using the on-site ground water elevations compared to the elevation of the Des Plaines River, approximately one mile away, the hydrau-

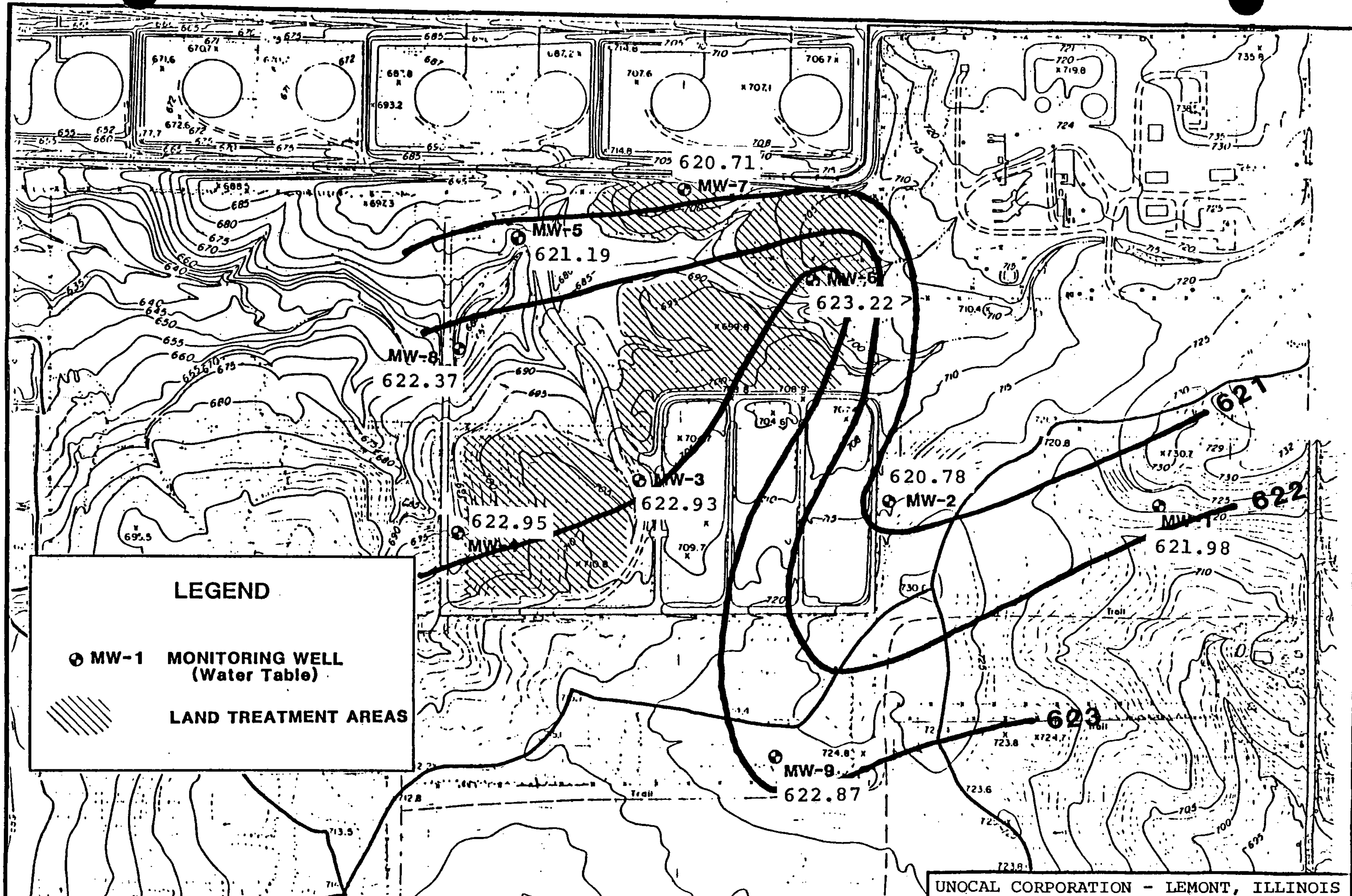


UNOCAL CORPORATION - LEMONT, ILLINOIS

FIGURE 10

GROUNDWATER CONTOURS

JUNE 18, 1984



CHICAGO AERIAL SURVEY
2140 WOLF ROAD
DES PLAINES, ILLINOIS 60018
312.298.1480
Revised October 1976

T. M. GATES INC.

200 0 200 400 600 800 1000

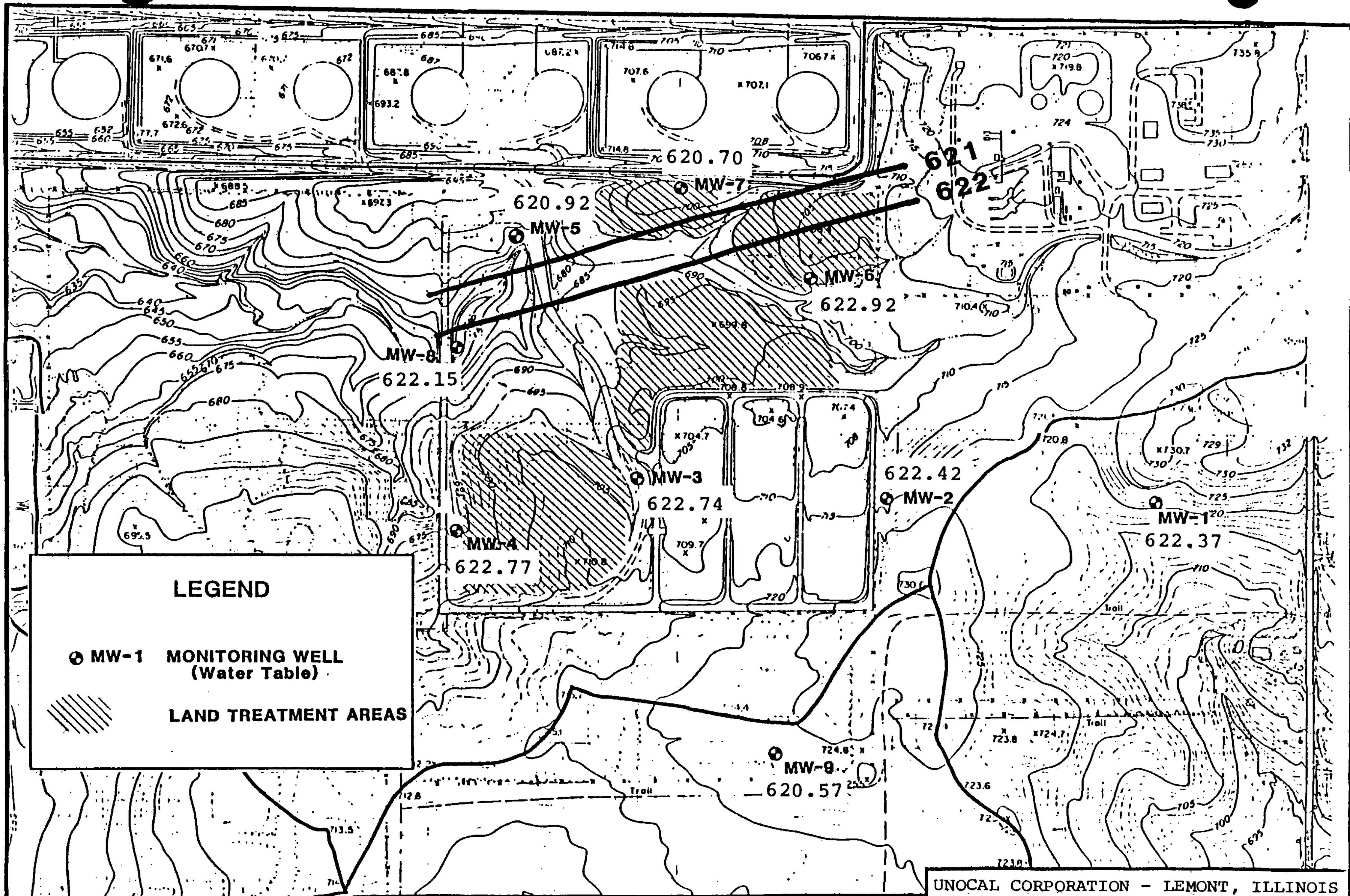
DATE OF AERIAL PHOTOGRAPHS: 1/25/73 | C.A.S. PROJECT NUMBER: CO 9456
CAMERA FOCAL LENGTH: 88.54 mm. | CONTOUR INTERVAL: 1 FOOT

UNOCAL CORPORATION - LEMONT, ILLINOIS

FIGURE 11

GROUNDWATER CONTOURS

SEPTEMBER 13, 1984



CHICAGO AERIAL SURVEY
2140 WOLF ROAD
DES PLAINES, ILLINOIS 60018
312.298.1480
Revised October 1976

T. M. GATES INC.

200 0 200 400 600 800 1000

DATE OF AERIAL PHOTOGRAPHS: 1/25/73 | C. A. S. PROJECT NUMBER: CO 9456

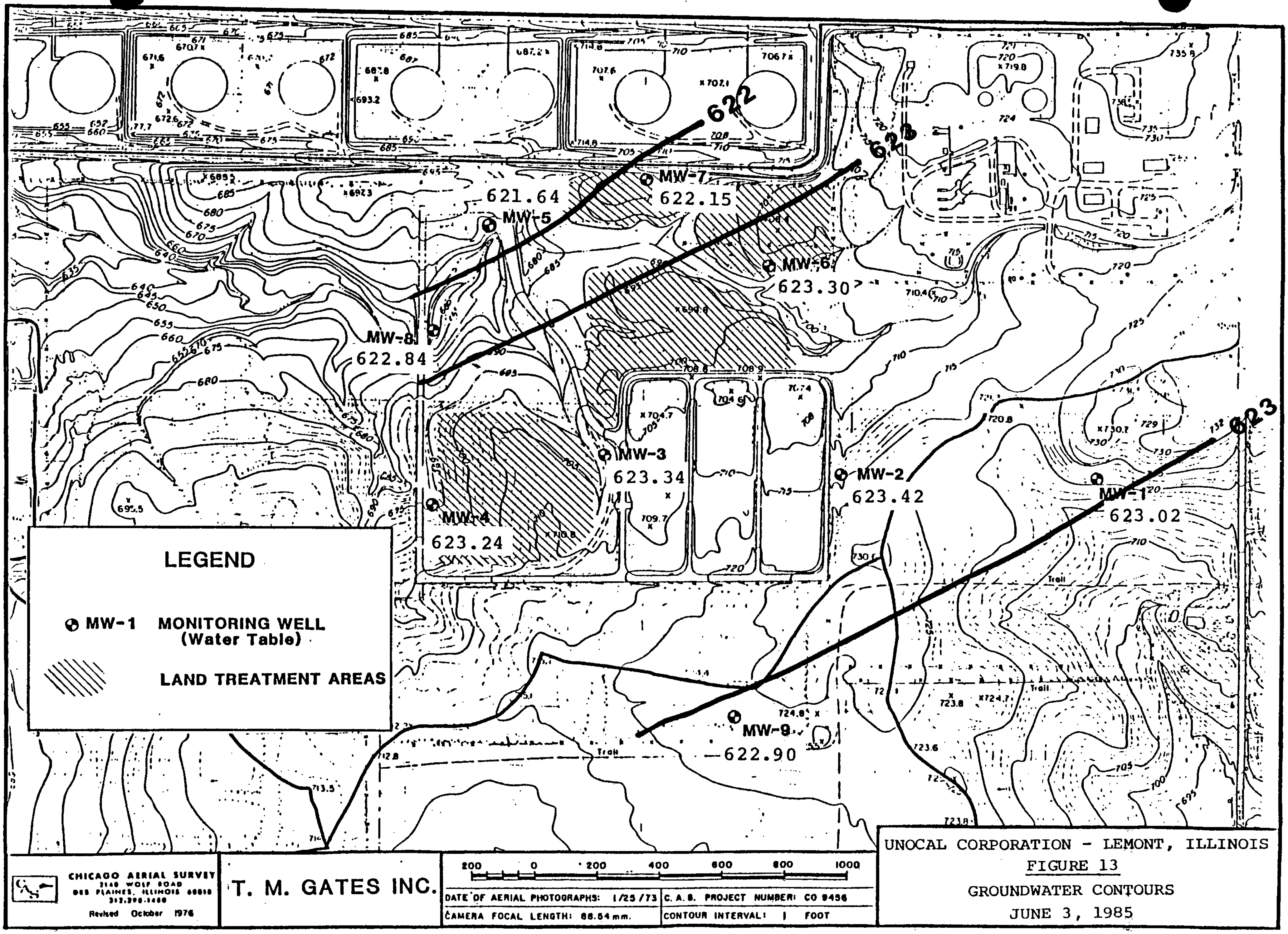
CAMERA FOCAL LENGTH: 88.54 mm. | CONTOUR INTERVAL: 1 FOOT

UNOCAL CORPORATION - LEMONT, ILLINOIS

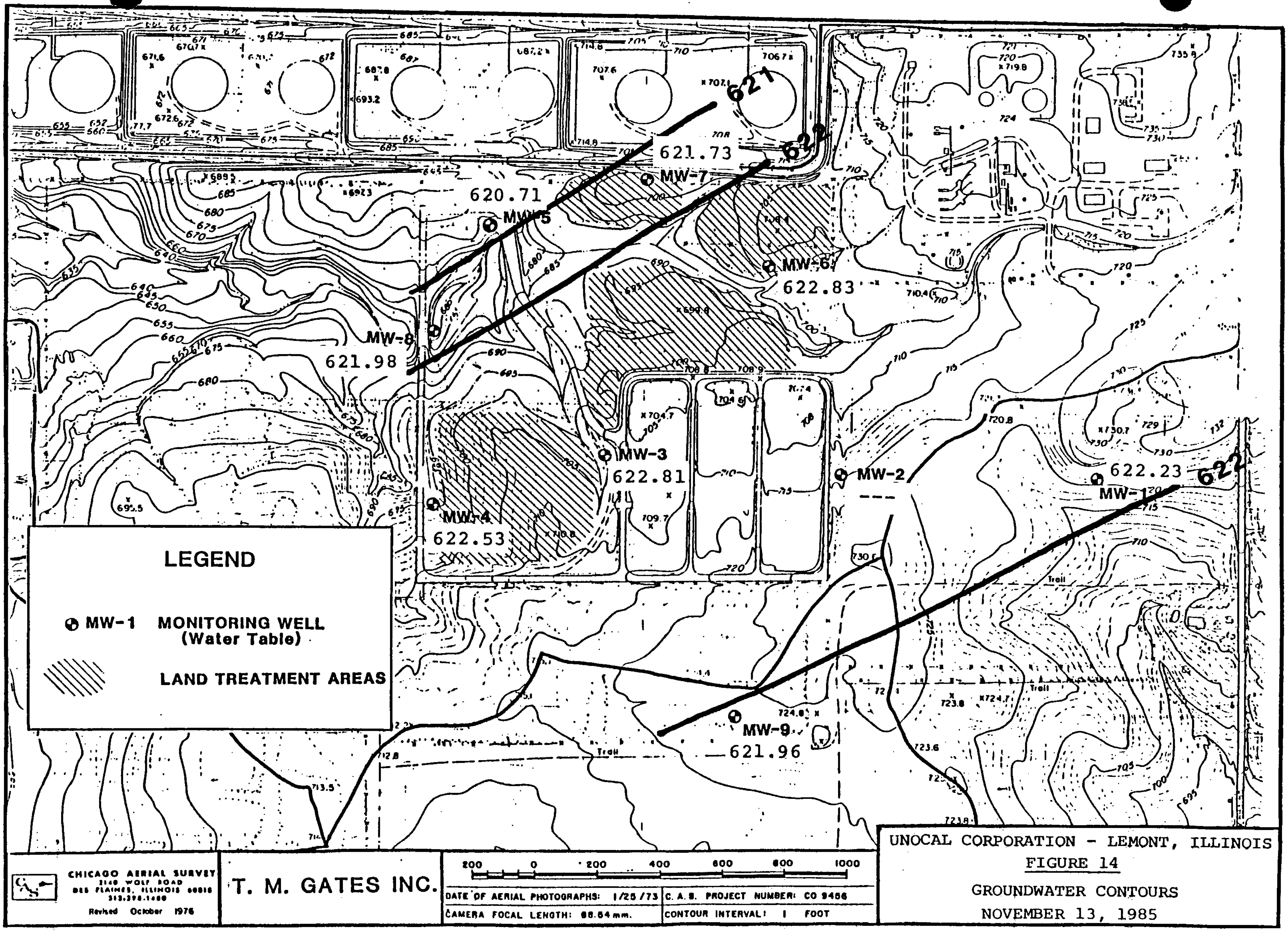
FIGURE 12

GROUNDWATER CONTOURS

NOVEMBER 28, 1984



LEGEND
MW-1 MONITORING WELL (Water Table)
LAND TREATMENT AREAS
622
623
623
MW-7
622.15
621.64
MW-5
MW-6
623.30
MW-8
622.84
MW-3
623.34
MW-2
623.42
MW-1
623.02
MW-4
623.24
MW-9
622.90
Trail
CHICAGO AERIAL SURVEY
Revised October 1976
T. M. GATES INC.
200 0 200 400 600 800 1000
DATE OF AERIAL PHOTOGRAPHS: 1/25/73
C. A. S. PROJECT NUMBER: CO 9456
CAMERA FOCAL LENGTH: 88.54 mm.
CONTOUR INTERVAL: 1 FOOT
UNOCAL CORPORATION - LEMONT, ILLINOIS
FIGURE 13
GROUNDWATER CONTOURS
JUNE 3, 1985



UNOCAL CORPORATION - LEMONT, ILLINOIS

FIGURE 14

GROUNDWATER CONTOURS

NOVEMBER 13, 1985

lic gradient was found to be 0.0074. Therefore, the typical hydraulic gradient is assumed to be approximately 0.007 in a northwesterly direction. It should be noted that because of the distance from the land application area of the river/canal system; the fact that the water level in the river/canal system is regulated; and the fact that observed variations in the water level appear to be seasonally related, it is unlikely that the river/canal system has any affect on the hydrogeologic environment underlying the land treatment area. It is likely however that some portion of the groundwater underlying the land application area migrates toward and eventually discharges into the river/canal system.

The permeability of the subsurface soils and bedrock can vary significantly depending upon the variations in silt and clay content and the density of fractures and/or solution cavities, respectively. Based on field inspection, physical testing (Appendix B), the information available in the literature, the following permeability coefficients are believed to be representative of the subsurface soil and bedrock units.

SOIL OR ROCK UNIT	PERMEABILITY COEFFICIENT
Clayey silts (ML)	10^{-4} to 10^{-6} cm/sec
Silty clays (CL)	10^{-6} to 10^{-8} cm/sec
Silty, clayey fine to coarse sands (SM/SC)	10^{-4} to 10^{-8} cm/sec
Limestone bedrock	10^{-3} to 10^{-8} cm/sec

Additionally, using the grain size distribution curves contained in Appendix B and Hazen's method to calculate permeabilities, Table 4 has been prepared which presents

TABLE 4

UNIFIED AND USDA TEXTURAL CLASSIFICATIONS OF BORING SAMPLES AND CALCULATED PERMEABILITIES USING HAZEN'S METHOD

BORING	SAMPLE	DEPTH (FT.)	UNIFIED GROUP SYMBOL	CALCULATED PERMEABILITY (cm/sec)	USDA TEXTURAL CLASSIFICATION
MW-1	S-6	25.0 to 26.5	CH	1.6×10^{-7}	Dark grey silty clay loam
	S-18	85.0 to 86.5	ML	4.2×10^{-5}	Light grey gravelly silty loam
	S-21	100.0 to 101.5	ML	3.0×10^{-5}	Light grey silty loam
MW-2	S-6	25.0 to 26.5	SM	1.7×10^{-6}	Brown sandy loam
	S-18	85.0 to 86.5	ML	3.2×10^{-8}	Light grey gravelly clay loam
	S-21	100.0 to 101.5	CL	3.6×10^{-7}	Grey gravelly silty loam
MW-3	S-6	29.5 to 30.0	CH	2.0×10^{-7}	Dark grey silty clay loam
	S-11	53.5 to 55.0	CH	5.3×10^{-8}	Dark grey silty clay loam
	S-17	85.5 to 86.5	ML	4.9×10^{-5}	Light grey silt
MW-5	S-5	23.5 to 25.0	ML-CL	3.6×10^{-7}	Grey gravelly silty loam
	S-8	38.5 to 40.0	ML-CL	2.3×10^{-6}	Light grey gravelly silty loam
	S-15	73.5 to 75.0	CL	6.3×10^{-6}	Light grey gravelly silty loam
MW-6	S-5	20.0 to 21.5	CL	3.6×10^{-6}	Dark grey silty loam
	S-9	40.0 to 41.5	CL	1.3×10^{-7}	Grey gravelly silty loam
	S-17	80.0 to 81.5	ML	4.2×10^{-5}	Light grey silt

calculated permeabilities for the various subsurface strata. It should be noted that Hazen's method will yield conservatively high permeabilities because it assumes Darcy's Law which excludes the effects of small particle size and the effects of preferred orientation caused by platey minerals. Therefore, the permeabilities shown in Table 4 can be considered to be higher than that which would be found in the in-situ natural environment. It should be noted that other than demonstrating that an appreciable thickness of low permeability soils underly the land treatment area and possibly estimating the vertical time-of-travel from the land application area to the water table, that the permeability of the clayey silt and silt clays has no relevance in determining the rate and direction of groundwater flow in the uppermost aquifer. Rather, the rate and direction of groundwater flow will depend on the hydraulic gradient, porosity and permeability of the strata in the upper most aquifer immediately below the water table. As previously described, this will involve aquifers generally near the soil/bedrock interface which at some well locations will be the fine-coarse glacial sand and at other locations will be the Niagaran dolomite. In either case, these units are hydraulically connected and act as a single aquifer which may have variable permeabilities but flow under the influence of a common hydraulic gradient.

As a check on the estimated permeability near the bedrock/soil interface (i.e., zone in which principle contaminant migration would occur) an in-situ field permeability test was performed at monitoring well MW-1. The results of this test indicated an average permeability for the silty sand surrounding the well screen of 3.56×10^{-5} cm/sec. The conditions at MW-1 are believed to be characteristic of the glacial clayey, silty sands generally overlying the bedrock and occurring as layers coincident with the top of the water table.

Using the hydraulic gradient and permeability referenced above (0.007 and 3.56×10^{-5}, respectively) and assuming a porosity of 30%, the rate of ground water flow near the soil/bedrock interface (i.e., top of water table) is approximately 8×10^{-7} cm/sec or 2.3×10^{-3} ft/day in a northwesterly direction.

Therefore, on the basis of the above information contained in Attachment 1 and the recommendation of the United States Environmental Protection Agency - Environmental Engineering Committee - Science Advisory Board that:

> "The site can be considered "characterized" at such a time as the geologic materials, groundwater level, and groundwater flow direction (in the different geologic units), can be accurately predicted before drilling."

UNOCAL believes that the hydrogeologic environment underlying the Chicago Refinery's land application area has been adequately characterized, and requires no further investigative effort.

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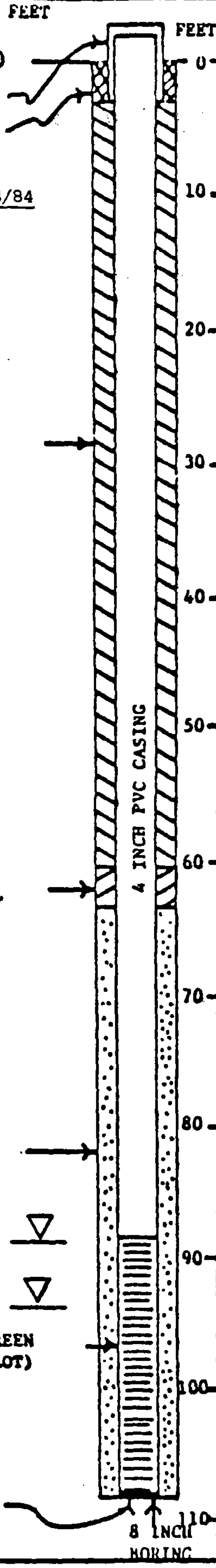
APPENDIX A

BORING LOGS AND
WELL CONSTRUCTION DIAGRAMS

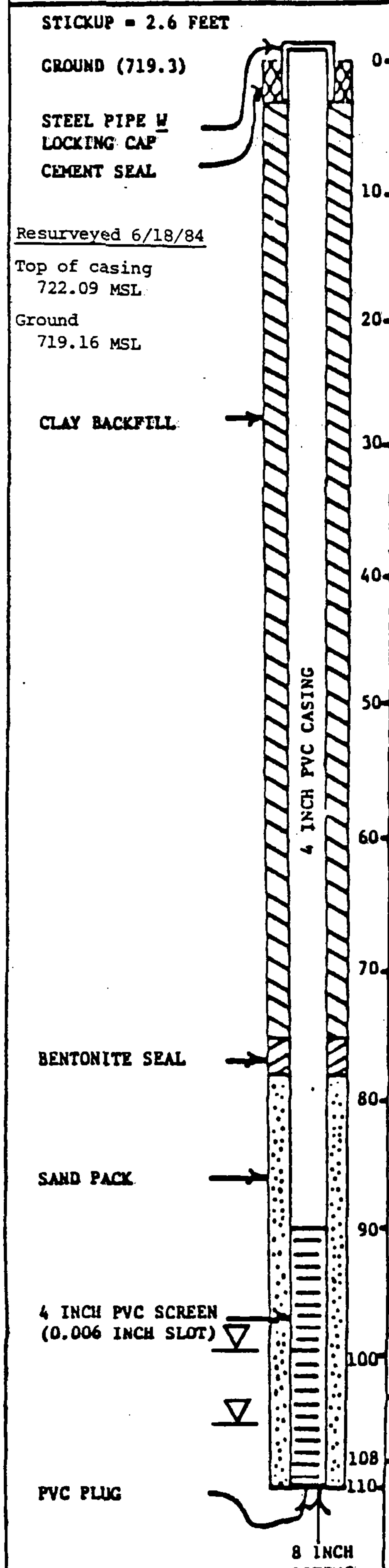
WELL CONSTRUCTION DETAILS	GENERALIZED LITHOLOGIC DESCRIPTION
STICKUP = 2.8 FEET	BROWN MOTTLED TAN AND GREY CLAYEY SILT WITH TRACE FINE GRAVEL AND ORGANIC MATERIAL
GROUND (715.0) STEEL PIPE W LOCKING CAP CEMENT SEAL	TAN MOTTLED GREY CLAYEY SILT WITH LITTLE FINE TO MEDIUM GRAVEL
Resurveyed 6/18/84 Top of casing 717.91 MSL Ground 715.06 MSL	
CLAY BACKFILL	GREY SILTY CLAY WITH TRACE FINE GRAVEL
	GREYISH BROWN SILTY CLAY
	GREYISH TAN CLAYEY SILT WITH SOME VERY COARSE SAND AND FINE GRAVEL
	BROWNISH GREY CLAYEY SILT WITH LITTLE FINE GRAVEL
BENTONITE SEAL	BROWNISH GREY SILTY CLAY WITH LITTLE FINE GRAVEL
	TAN SILTY FINE SAND AND ROCK FRAGMENTS
	GREY SILTY MEDIUM TO FINE SAND AND ROCK FRAGMENTS
SAND PACK	GREY SILTY FINE TO VERY FINE SAND WITH LITTLE FINE GRAVEL AND ROCK FRAGMENTS
	GREY SILTY MEDIUM TO FINE SAND WITH LITTLE FINE GRAVEL
	TAN MEDIUM SAND
4 INCH PVC SCREEN (0.006 INCH SLOT)	GREY SILTY FINE TO VERY FINE SAND WITH LITTLE FINE GRAVEL
	DARK GREY CLAYEY SILT AND DOLOMITE FRAGMENTS (WET)
PVC PLUG	DOLOMITE BEDROCK; BOTTOM OF BORING (111.5)



Converse/TenEch Geotechnical and Environmental Consultants

UNION OIL - CHICAGO REFINERY
HYDROGEOLOGIC INVESTIGATION
APPENDIX A
MW-1

WELL CONSTRUCTION DETAILS	GENERALIZED LITHOLOGIC DESCRIPTION



GENERALIZED LITHOLOGIC DESCRIPTION
BROWN MOTTLED TAN SILTY CLAY WITH LITTLE ORGANIC MATERIAL
BROWN MOTTLED TAN AND GREY SILTY CLAY WITH TRACE FINE GRAVEL
BROWN MOTTLED GREY SILTY CLAY WITH LITTLE COARSE GRAVEL
BROWN MOTTLED DARK GREY TO BLACK SILTY CLAY WITH TRACE FINE GRAVEL
BROWN CLAYEY FINE SAND WITH SOME MEDIUM TO COARSE GRAVEL
BROWN MEDIUM SAND
BROWN SILTY CLAY WITH LITTLE TO TRACE MEDIUM GRAVEL
GREY SILTY CLAY WITH TRACE MEDIUM TO COARSE GRAVEL
BROWNISH GREY SILTY CLAY WITH TRACE FINE GRAVEL
GREYISH BROWN SANDY CLAY WITH SOME FINE GRAVEL
GREY SILTY MEDIUM TO COARSE SAND
GREY SILTY CLAY WITH TRACE FINE GRAVEL
GREY CLAYEY SILTY FINE TO MEDIUM SAND WITH LITTLE FINE GRAVEL AND ROCK FRAGMENTS
DARK GREY CLAYEY SILT AND DOLOMITE FRAGMENTS (WET)
DOLOMITE BEDROCK; BOTTOM OF BORING (116.5)

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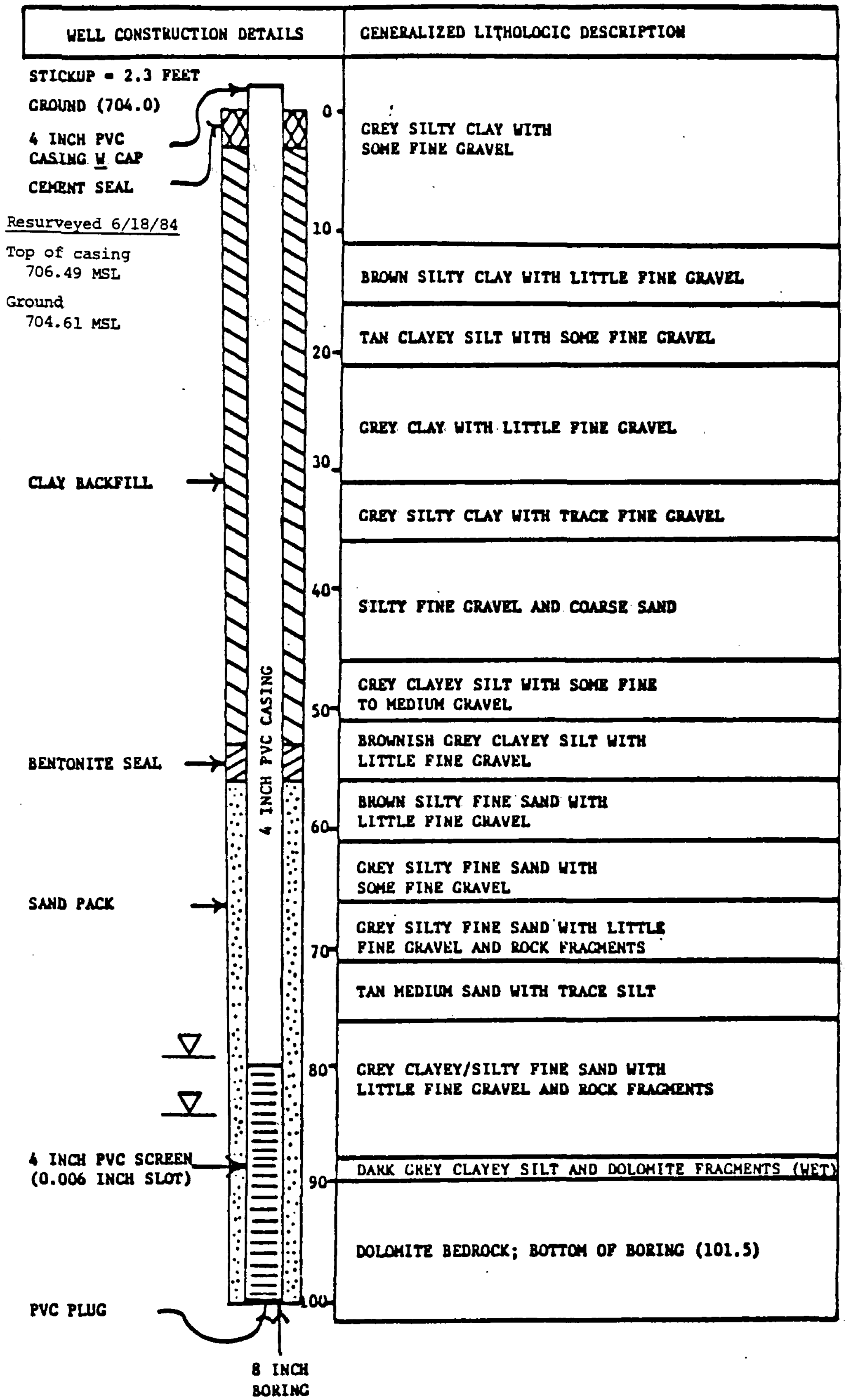
UNION OIL - CHICAGO REFINERY
HYDROGEOLOGIC INVESTIGATION
APPENDIX A - MW-2
BORING LOG AND WELL DETAILS



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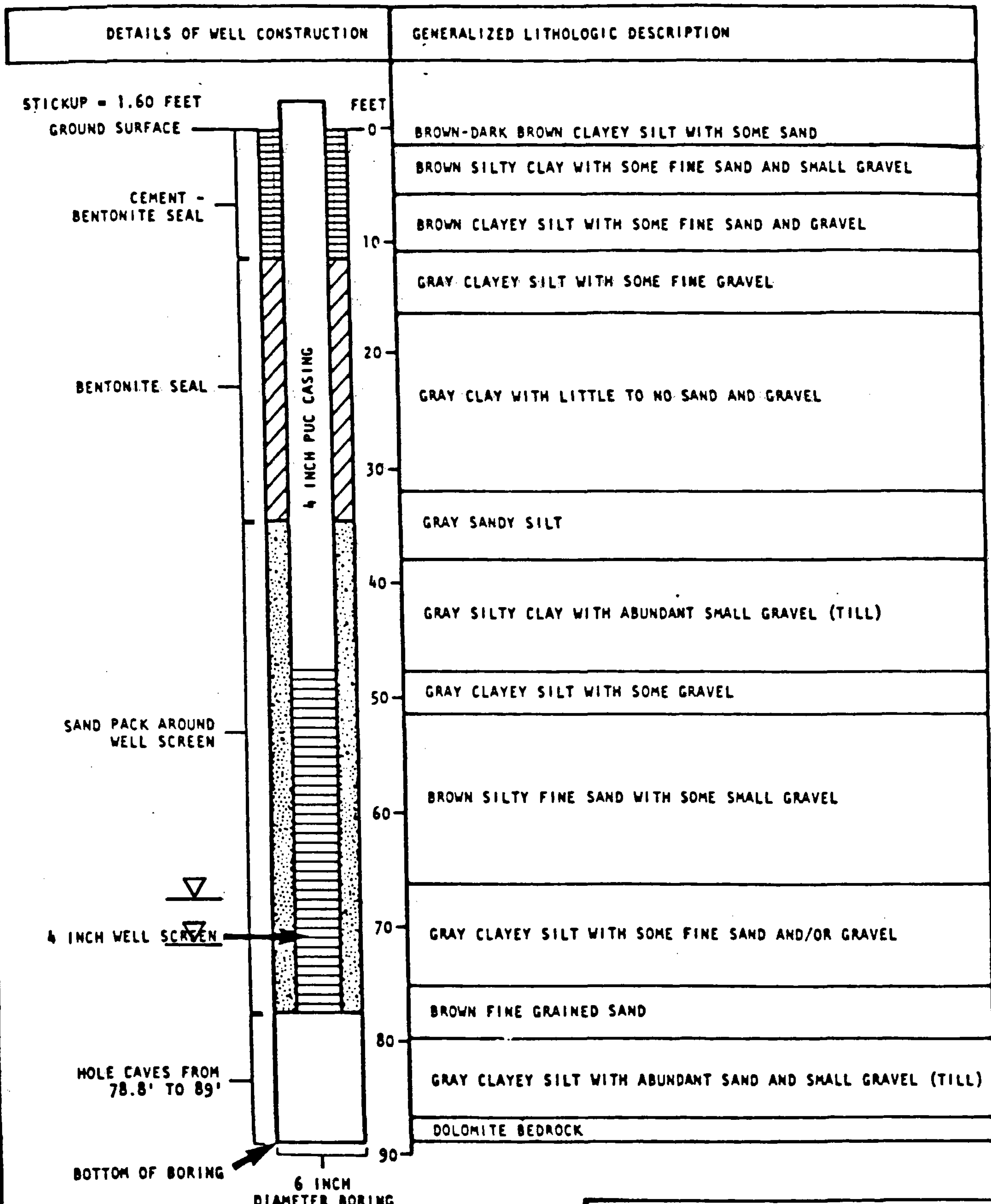
UNION OIL - CHICAGO REFINERY
HYDROGEOLOGIC INVESTIGATION
APPENDIX A
MW-3
BORING LOG AND WELL DETAILS



Resurveyed 6/18/84

Top of casing
694.43 MSL

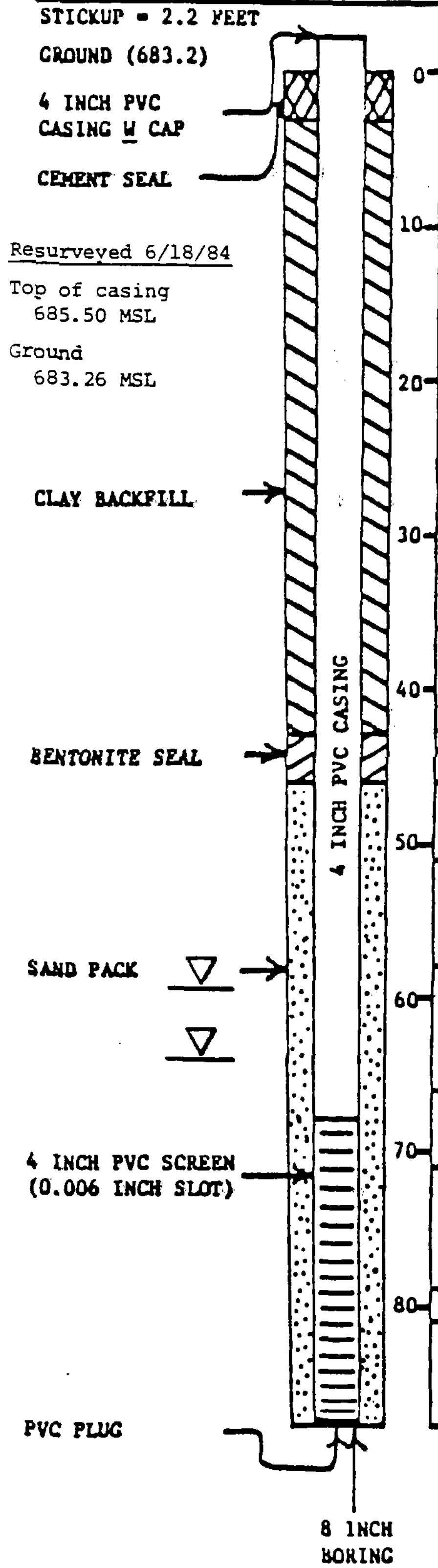
Ground
692.80 MSL

UNION OIL OF CALIFORNIA

FIGURE 3

LITHOLOGIC DESCRIPTION AND WELL CONSTRUCTION SPECIFICATIONS FOR WELL NO. 4

WELL CONSTRUCTION DETAILS	GENERALIZED LITHOLOGIC DESCRIPTION



BROWN CLAYEY SILT WITH LITTLE TO TRACE FINE GRAVEL

TAN SILTY COARSE SAND WITH LITTLE FINE GRAVEL

GREY SILTY SAND WITH LITTLE FINE GRAVEL AND ROCK FRAGMENTS

GREY CLAYEY SILT WITH FEW ROCK FRAGMENTS

TAN SILTY FINE SAND WITH SOME FINE GRAVEL

GREY SILTY FINE SAND WITH SOME FINE TO MEDIUM GRAVEL

TAN SILTY VERY FINE TO MEDIUM SAND

TAN MEDIUM SAND

TAN FINE TO COARSE SAND WITH LITTLE FINE GRAVEL

GREY CLAYEY SILT WITH TRACE FINE GRAVEL

GREY FINE TO MEDIUM SAND

GREYISH TAN SILTY FINE SAND WITH SOME FINE TO MEDIUM GRAVEL

DARK GREY CLAYEY SILT WITH LITTLE FINE GRAVEL (WET)

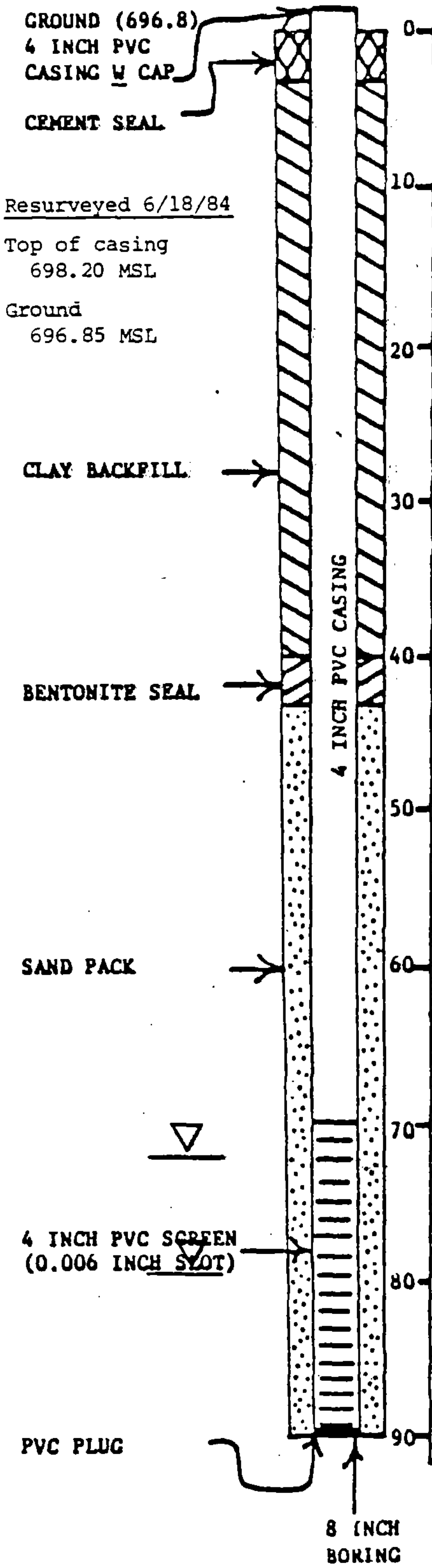
DOLOMITE BEDROCK; BOTTOM OF BORING (88.0)

Converse/TenEch Geotechnical and Environmental Consultants

UNION OIL - CHICAGO REFINERY
HYDROGEOLOGIC INVESTIGATION
APPENDIX A
MW-5
BORING LOG AND WELL DETAILS

WELL CONSTRUCTION DETAILS	GENERALIZED LITHOLOGIC DESCRIPTION

STICKUP = 1.4 FEET



GENERALIZED LITHOLOGIC DESCRIPTION
BROWN SILT WITH LITTLE ORGANIC MATERIAL
TAN MOTTLED GREY CLAYEY SILT WITH LITTLE FINE GRAVEL
TAN SILTY MEDIUM SAND WITH SOME FINE GRAVEL
DARK GREY CLAYEY SILT WITH TRACE FINE GRAVEL
GREYISH TAN SILTY FINE TO COARSE GRAVEL WITH SOME FINE SAND
DARK GREY CLAYEY SILT WITH SOME FINE TO COARSE GRAVEL
GREYISH TAN SILTY FINE TO COARSE GRAVEL WITH SOME FINE SAND
DARK GREY CLAYEY SILT WITH TRACE MEDIUM GRAVEL
GREYISH TAN SILTY MEDIUM SAND WITH ROCK FRAGMENTS
GREY CLAYEY/SILTY FINE TO MEDIUM SAND WITH LITTLE FINE GRAVEL AND ROCK FRAGMENTS
GREY FINE TO COARSE SAND
GREY CLAYEY FINE SAND WITH TRACE COARSE GRAVEL
GREY CLAYEY SILT WITH TRACE FINE GRAVEL
BROWNISH GREY CLAYEY FINE SAND (WET)
DOLOMITE BEDROCK; BOTTOM OF BORING (91.5)

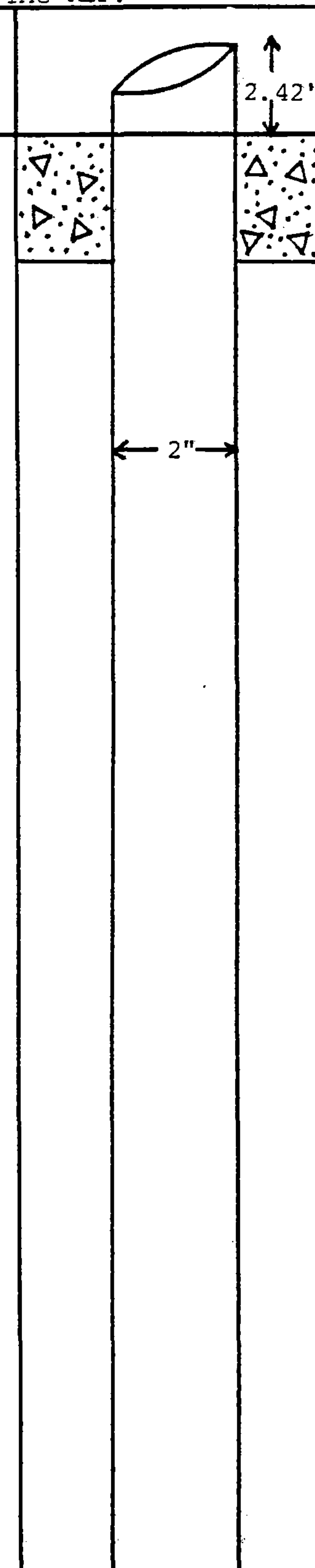
Converse/TenEch Geotechnical and Environmental Consultants

UNION OIL - CHICAGO REFINERY
HYDROGEOLOGIC INVESTIGATION
APPENDIX A
MW-6
BORING LOG AND WELL DETAILS

T. M. GATES, INC.	TEST BORING LOG & MONITORING WELL INSTALLATION	WELL NO. MW-7

PROJECT	UNION OIL SUPPLEMENTAL WELLS							SHT. NO. 1 OF 5
CLIENT	UNION OIL COMPANY							PROJ. NO. 84-01-008
BORING CONTRACTOR	CANONIE CONSTRUCTION COMPANY							GROUND ELEV. 699.5
GROUND WATER	TOC-ELEV. 701.96				CAS.	SAMP.	CORE	TUBE	DATUM MSL
DATE	TIME	ELEV.	CASING	TYPE	H.S.A.	S.S.			DATE START 3-22-84
4-09-84	4:00pm	618.82		DIA.	6"	1 1/2"			DATE FINISH 4-02-84
				WT.		140#			DRILLER J. HAMMAN
				FALL		30"			TMG-REP. GJY

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION & REMARKS
1					
2					No Sample 0-38.5'
3					Same lithologic description
4					as adjacent SW-7
5					Begin sampling at 38.5'
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					



FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS, SEE TEXT

T. M. GATES, INC.	TEST BORING LOG & MONITORING WELL INSTALLATION	WELL NO. MW-7
PROJECT UNION OIL SUPPLEMENTAL WELLS		SHT. NO. 2 OF 5
CLIENT UNION OIL COMPANY		PROJ. NO. 84-01-008

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION & REMARKS	
24						
25					No Sample 0-38.5' Same lithologic description as adjacent SW-7	
26						
27					Boulder	
28						
29						←2" →
30						
31						
32						
33						
34						
35					Boulder	
36						
37						
38						
39		S-1	3 6 7	CL ML	Dark gray silty clay/clayey silt, stiff, trace to some gravel, moist	
40					(Convert to rotary wash drilling)	
41						
42						
43		S-2	70		Boulder	
44						
45						
46						
47						
48		S-3	50+		Same as above, trace silt	
49						

FOR INTERPRETATION OF SOIL ROCK AND GROUNDWATER CONDITIONS SEE TEXT

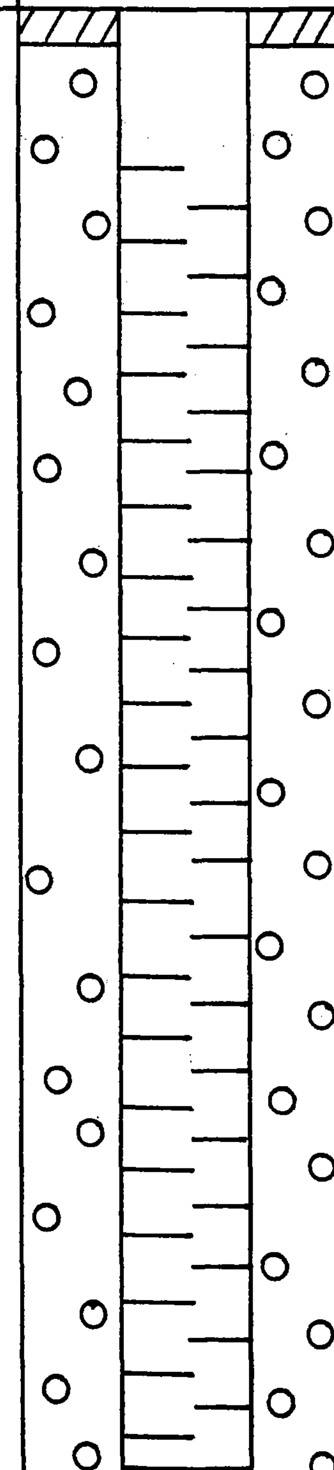
T. M. GATES, INC.	TEST BORING LOG & MONITORING WELL INSTALLATION	WELL NO. MW-7
PROJECT: UNION OIL SUPPLEMENTAL WELLS		SHT. NO. 3 OF 5
CLIENT: UNION OIL COMPANY		PROJ. NO. 84-01-008

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION & REMARKS	
50						
51						
52						
53						
54						
55		S-4	8 23 25	CL/ML	Dark gray clayey silt/silty clay, soft, moist, trace gravel	2"
56						
57						
58		S-5	20 50	ML/SM	Dark gray clayey silt, dense, wet; overlying light gray clayey silty fine sand, dense, slightly moist, trace gravel throughout	
59						
60						
61						
62						
63						
64		S-6		ML	Dark gray clayey, fine sandy, gravelly silt, dense, wet	
65						
66						
67						
68						
69						
70		S-7		CL	Dark gray fine sandy silty clay, very stiff, wet, trace gravel	
71						
72						
73						
74						
75						

FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS SEE TEXT

T. M. GATES, INC.	TEST BORING LOG & MONITORING WELL INSTALLATION	WELL NO. MW-7
PROJECT UNION OIL SUPPLEMENTAL WELLS		SHT. NO. 4 OF 5
CLIENT UNION OIL COMPANY		PROJ. NO. 84-01-008

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION & REMARKS
76		S-8	50+		No sample recovered
77					
78					
79					
80	∇	S-9	50+	ML	Brown clayey silt, dense, wet trace gravel (High blow count due to cuttings that spoon was driven through)
81					
82					
83	∇				
84					
85		S-10	50+		No sample recovered
86					
87					
88					
89					
90		S-11	50+	ML	Gray fine sandy silt, dense, wet (High blow count due to cuttings)
91					
92					
93					
94					
95		S-12			No sample recovered
96					
97					
98		E.O.B			97.3'
99					
100					
101					



FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS, SEE TEXT

T. M. GATES, INC.	TEST BORING LOG & MONITORING WELL INSTALLATION	WELL NO. MW-7
PROJECT UNION OIL SUPPLEMENTAL WELLS		SHT. NO. 5 OF 5
CLIENT UNION OIL COMPANY		PROJ. NO. 84-01-008

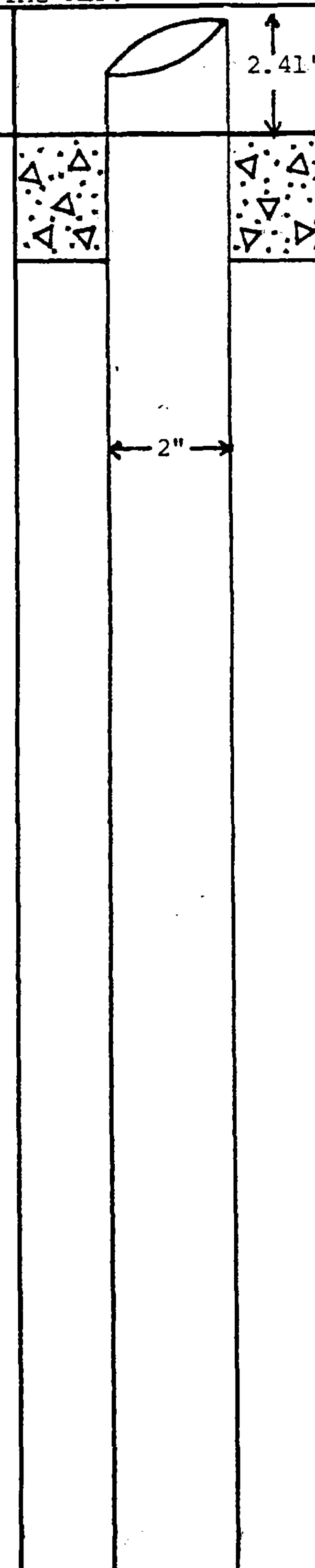
DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION & REMARKS	
					WELL CONSTRUCTION 0.006 in. slot PVC screen: 97.3'-77.3' Washed concrete sand: 97.3'-75.5' Bentonite pellet seal: 75.5'-73.5' Native clay backfill: 73.5'-2' Concrete plug: 2'-0' -Height of steel protective casing above ground surface is 2.42 feet. -Well developed by bailing at least 5 times the volume of water in the well.	

FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS, SEE TEXT

T. M. GATES, INC.	TEST BORING LOG & MONITORING WELL INSTALLATION	WELL NO. MW-8

PROJECT	UNION OIL SUPPLEMENTAL WELLS							SHT. NO.	1 OF 3
CLIENT	UNION OIL COMPANY							PROJ. NO.	84-01-008
BORING CONTRACTOR	CANONIE CONSTRUCTION COMPANY							GROUND ELEV.	668.0
GROUND WATER	TOC-ELEV. 670.38				CAS.	SAMP.	CORE	TUBE	DATUM MSL
DATE	TIME	ELEV.	CASING	TYPE	H.S.A.	S.S.			DATE START 3-19-84
3-22-84	2:00pm	623.48		DIA.	6"	1 1/2"			DATE FINISH 3-20-84
				WT.		140#			DRILLER J. HAMMAN
				FALL		30"			TMG-REP. GJY

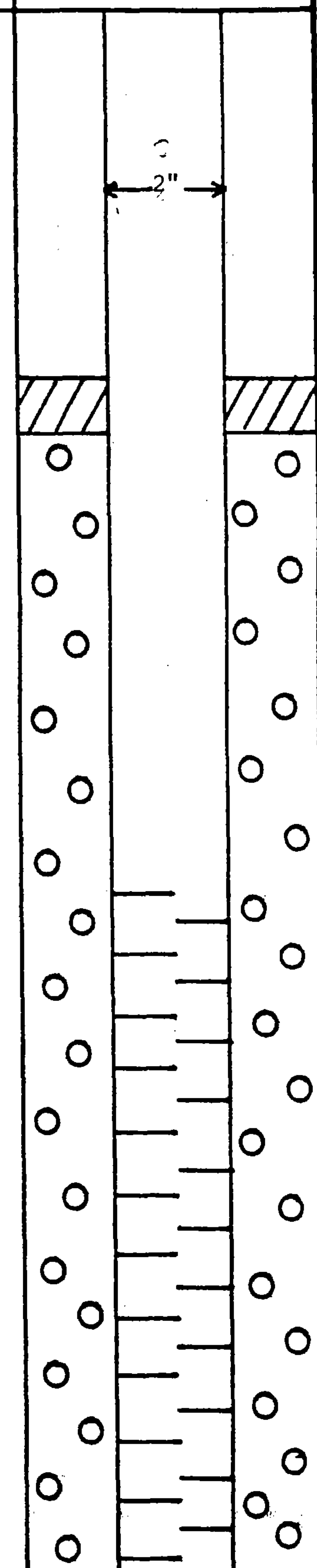
DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION & REMARKS
1					
2					
3		S-1	3 4 6	CL ML	Dark gray silty clay/clayey silt, firm, moist
4					
5					
6					
7					
8		S-2	15 21 22	ML SM	Gray clayey silt; overlying rust brown clayey silt; overlying light brown silty fine sand; trace gravel throughout, dense, wet
9					
10		S-3	12 18 71	ML	Dark gray, clayey silt, dense, moist, trace gravel
11					
12					
13		S-4	3 4 6	CL	Dark gray silty clay, firm, moist, some gravel
14					
15		S-5	9 12 12	ML	Light brown fine sandy, silt, dense, moist, trace gravel
16					
17					
18		S-6	12 22 32	ML	Light brown clayey fine sandy silt, dense, moist; overlying light brown clayey silt, dense, moist, trace gravel
19					
20		S-7	28 27 32	ML	Light brown clayey fine sandy silt, dense, wet, trace gravel
21					
22					
23		S-8	4		



FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS, SEE TEXT

T. M. GATES, INC.	TEST BORING LOG & MONITORING WELL INSTALLATION	WELL NO. MW-8
PROJECT UNION OIL SUPPLEMENTAL WELLS		SHT. NO. 2 OF 3
CLIENT UNION OIL COMPANY		PROJ. NO. 84-01-008

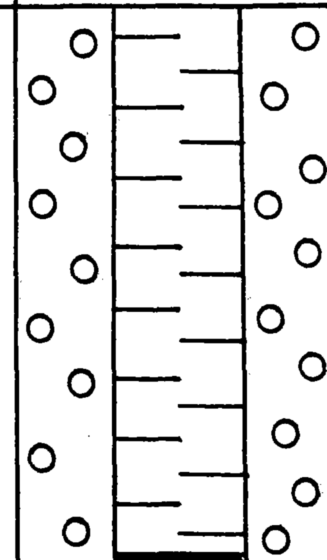
DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION & REMARKS
		S-8	10 4	ML	Dark gray fine sandy clayey silt, loose, moist, trace gravel
24					
25					
26		S-9	4 8 15	ML	Same as above
27					
28		S-10	2 2 4	ML CL	Dark gray silty clay, firm, moist, trace sand and gravel
29					
30					
31		S-11	1 3 3	ML CL SW	Dark gray fine to medium grained sandy clayey silt/silty clay, loose, moist; overlying rust-brown fine sand; overlying brown fine to medium sand, loose, moist
32					
33		S-12	14 20 45	ML SP	Brown fine sandy clayey silt, dense, moist; overlying light brown silty fine sand, dense, moist
34					
35					
36					
37					
38		S-13	10 12 17	ML	Gray fine sandy clayey silt, loose, moist, some gravel
39					
40					
41					
42					
43		S-14	11 13 12	ML	Dark gray clayey fine sandy silt, loose, moist, trace gravel
44	▽				
45					
46	▽				
47					
48		S-15	3 7 10	ML SM	Dark gray fine sandy clayey silt, loose, moist, overlying silty fine sand, loose, wet
49					



FOR INTERPRETATION OF SOIL ROCK AND GROUNDWATER CONDITIONS SEE TEXT

T. M. GATES, INC.	TEST BORING LOG & MONITORING WELL INSTALLATION	WELL NO. MW-8
PROJECT UNION OIL SUPPLEMENTAL WELLS		SHT. NO. 3 OF 3
CLIENT UNION OIL COMPANY		PROJ. NO. 84-01-008

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION & REMARKS
50					
51					
52					
53		S-16	4 6 8	SW	Dark gray fine to medium sand, loose, wet, trace gravel
54					
55					
56					
57					
58		E.O.B			
59					
60					
61					
62					
63					
64					
65					
66					
67					
68					
69					
70					
71					
72					
73					
74					
75					



WELL CONSTRUCTION

0.006 in. slot PVC screen: 57.5'-37.5'
Washed concrete sand: 57.5'-30'
Bentonite pellet seal: 30'-29'
Native clay backfill: 29'-2'
Concrete plug: 2'-0'

-Height of steel protective casing above ground surface is 2.41 feet.
-Well developed by bailing at least 3 times the volume of water in the well.

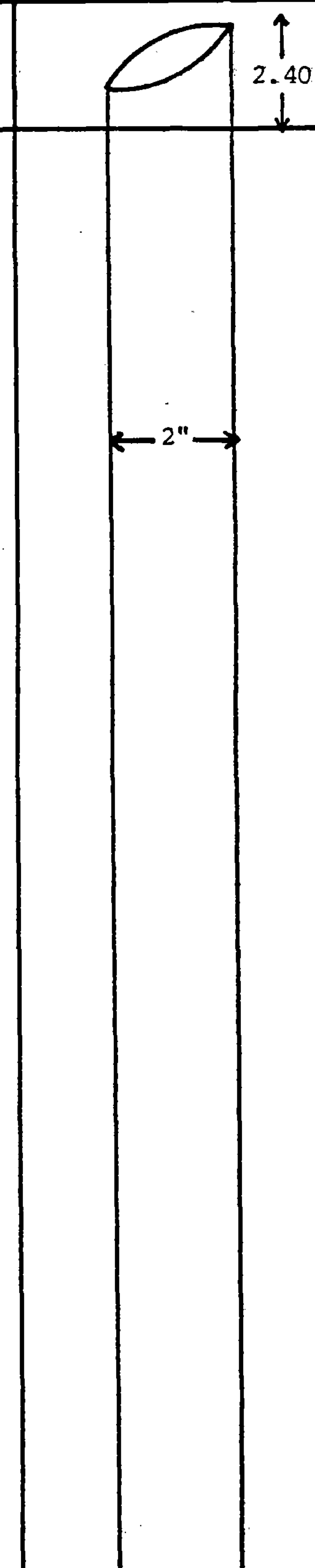
FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS, SEE TEXT

T. M. GATES, INC.	TEST BORING LOG & MONITORING WELL INSTALLATION	WELL NO. MW-9

PROJECT	UNION OIL SUPPLEMENTAL WELLS	SHT. NO. 1 OF 5
CLIENT	UNION OIL COMPANY	PROJ. NO. 84-01-008
BORING CONTRACTOR	CANONIE CONSTRUCTION COMPANY	GROUND ELEV. 723.0

GROUND WATER	TOC-ELEV. 725.25				CAS.	SAMP.	CORE	TUBE	DATUM MSL
DATE	TIME	ELEV.	CASING	TYPE	H.S.A.	S.S.			DATE START 3-13-84
3-22-84	2:30pm	621.45		DIA.	6"	1 1/2"			DATE FINISH 3-16-84
				WT.		140#			DRILLER J. HAMMAN
				FALL		30"			TMG-REP. GJY

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION & REMARKS
1					
2					
3					
4		S-1	8 12 18	CL	Brown and gray mottled silty clay, very stiff, slightly moist
5					
6					
7					
8					
9		S-2	9 14 22	CL	Grayish brown silty clay, trace gravel, very stiff, moist
10					
11					
12					
13					
14		S-3	6 8 12	CL	Brown silty clay, trace medium sand, trace gravel, firm, moist
15					
16					
17					
18					
19		S-4	4 9 14	CL	Same as above
20					
21					
22					
23					



FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS, SEE TEXT

T. M. GATES, INC.	TEST BORING LOG & MONITORING WELL INSTALLATION	WELL NO. MW-9
PROJECT UNION OIL SUPPLEMENTAL WELLS		SHT. NO. 2 OF 5
CLIENT UNION OIL COMPANY		PROJ. NO. 84-01-008

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION & REMARKS	
24		S-5	4 6 8	CL	Gray silty clay, trace fine sand, trace gravel, soft to firm, moist	
25						
26						
27						
28						
29		S-6	3 4 4	ML	Gray clayey silt, trace fine sand, trace gravel, very soft, wet	← 2" →
30						
31						
32		S-7	5 7 10	CL/ML	Gray clayey silt/silty clay, trace fine sand, trace gravel, firm, moist	
33						
34		S-8	4 6 9	CL/ML	Same as above	
35						
36						
37						
38						
39		S-9	4 5 7	CL/ML	Same as above	
40						
41						
42						
43						
44		S-10	6 7 9	CL/ML	Same as above	
45						
46						
47						
48						
49			5			

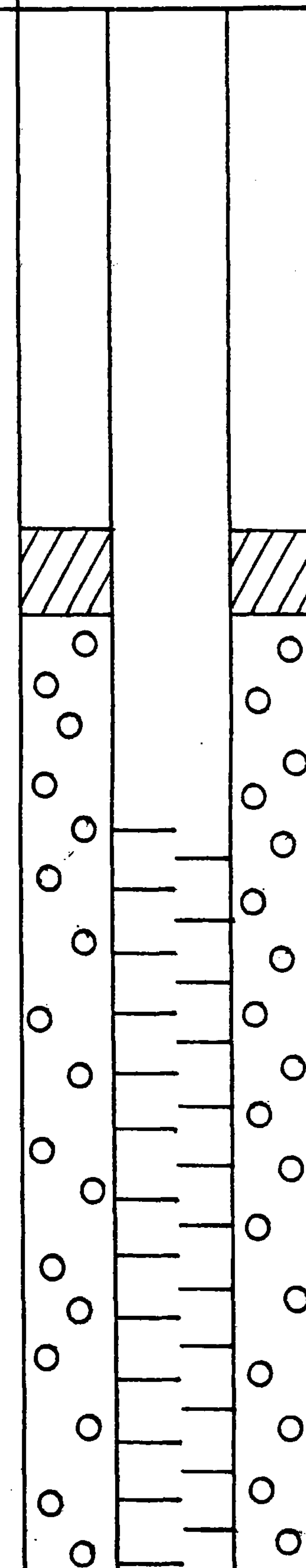
FOR INTERPRETATION OF SOIL ROCK AND GROUNDWATER CONDITIONS SEE TEXT

T. M. GATES, INC.	TEST BORING LOG & MONITORING WELL INSTALLATION	WELL NO. MW-9
PROJECT UNION OIL SUPPLEMENTAL WELLS		SHT. NO. 3 OF 5
CLIENT UNION OIL COMPANY		PROJ. NO. 84-01-008

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION & REMARKS	
		S-11	8 12	CL	Gray silty clay, trace gravel, firm, moist	
50						
51						
52						
53						
54		S-12	5 8 9	CL/ML	Gray silty clay, trace gravel, firm, moist; overlying gray clayey silt, loose, trace gravel, trace black decaying organic material	
55						2"
56						
57						
58						
59		S-13	19 60 52	ML	Gray clayey silt, trace to some gravel, dense, moist	
60						
61						
62						
63						
64		S-14	21 31 41	ML	Same as above	
65						
66						
67						
68						
69		S-15	5 10 13	CL	Gray silty clay, trace gravel, firm, moist	
70						
71						
72						
73						
74		S-16	4 10 15	CL	Same as above	
75						

T. M. GATES, INC.	TEST BORING LOG & MONITORING WELL INSTALLATION	WELL NO. MW-9
PROJECT UNION OIL SUPPLEMENTAL WELLS		SHT. NO. 4 OF 5
CLIENT UNION OIL COMPANY		PROJ. NO. 84-01-008

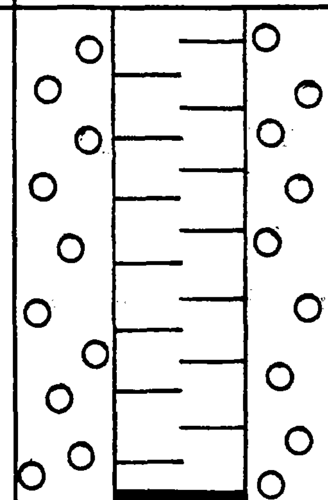
DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION & REMARKS
76					
77					
78					
79		S-17	3 10 9	ML	Gray clayey silt, loose, wet
80					
81					
82					
83					
84		S-18	50/5"		(Augers much harder) Limestone fragments (Convert to rotary wash drilling)
85					
86					
87					
88					
89					
90					
91					
92					
93					
94		S-19	6 20 20	CL ML	Gray silty clay/clayey silt trace gravel, moist, dense (Convert to 6" H.S.A.)
95					
96					
97					
98					
99	∇	S-20	15 15 19	ML	Gray clayey silt, wet, dense
100					
101					



FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS, SEE TEXT

T. M. GATES, INC.	TEST BORING LOG & MONITORING WELL INSTALLATION	WELL NO. MW-9
PROJECT UNION OIL SUPPLEMENTAL WELLS		SHT. NO. 5 OF 5
CLIENT UNION OIL COMPANY		PROJ. NO. 84-01-008

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION & REMARKS
102	∇				
103					
104					
105					
106					
107					
108		108.5'			
109		E.O.B.			
110					



WELL CONSTRUCTION

0.006 inc. slot PVC screen: 108.5'-88.5'
Washed concrete sand: 108.5'-85'
Bentonite pellet seal: 85'-83.5'
Native clay backfill: 83.5'-3'
Concrete plug: 3'-0'

- Height of steel protective casing above ground surface is 2.40 feet.
- Well developed by bailing at least 3 times the volume of water in the well.

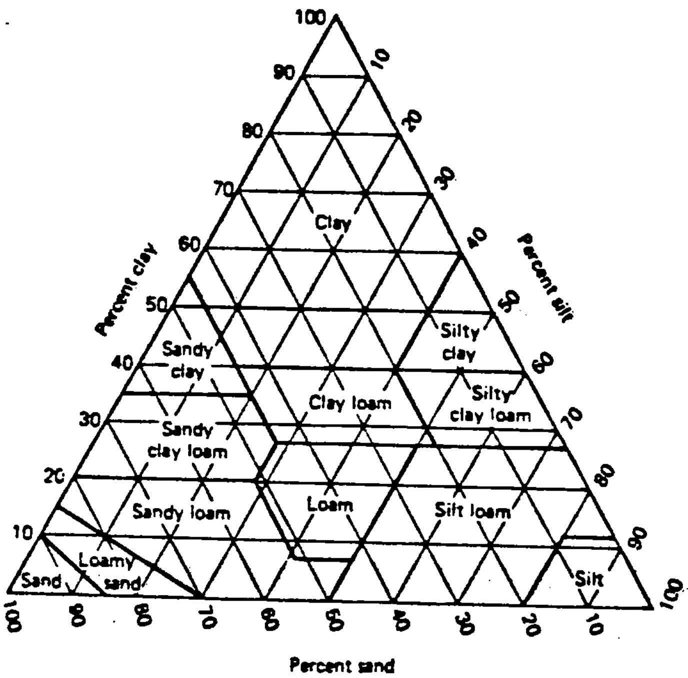
APPENDIX B

PHYSICAL TESTING

GRAIN SIZE DISTRIBUTION AND SOIL CLASSIFICATION

UNIFIED AND USDA TEXTURAL CLASSIFICATIONS OF BORING SAMPLES

BORING	SAMPLE	DEPTH (FT.)	UNIFIED GROUP SYMBOL	ESTIMATED PERMEABILITY (cm/sec)	USDA TEXTURAL CLASSIFICATION
B-1	S-1	0.0 to 1.5	CL	10^{-6} to 10^{-8}	Dark brown silty clay loam
	S-6	25.0 to 26.5	CH	10^{-6} to 10^{-8}	Dark grey silty clay loam
	S-18	85.0 to 86.5	ML	10^{-3} to 10^{-6}	Light grey gravelly silty loam
	S-21	100.0 to 101.5	ML	10^{-3} to 10^{-6}	Light grey silty loam
B-2	S-1	0.0 to 1.5	CL	10^{-6} to 10^{-8}	Brown silty clay loam
	S-6	25.0 to 26.5	SM	10^{-3} to 10^{-6}	Brown sandy loam
	S-18	85.0 to 86.5	ML	10^{-3} to 10^{-6}	Light grey gravelly clay loam
	S-21	100.0 to 101.5	CL	10^{-6} to 10^{-8}	Grey gravelly silty loam
B-3	S-1	3.5 to 5.0	CL	10^{-6} to 10^{-8}	Brown silty clay loam
	S-6	29.5 to 30.0	CH	10^{-6} to 10^{-8}	Dark grey silty clay loam
	S-11	53.5 to 55.0	CH	10^{-6} to 10^{-8}	Dark grey silty clay loam
	S-17	85.5 to 86.5	ML	10^{-3} to 10^{-6}	Light grey silt
B-5	S-1	3.5 to 5.0	CL	10^{-6} to 10^{-8}	Brown silty loam
	S-5	23.5 to 25.0	ML-CL	10^{-5} to 10^{-7}	Grey gravelly silty loam
	S-8	38.5 to 40.0	ML-CL	10^{-5} to 10^{-7}	Light grey gravelly silty loam
	S-15	73.5 to 75.0	CL	10^{-6} to 10^{-8}	Light grey gravelly silty loam
B-6	S-1	0.5 to 2.0	ML-CL	10^{-5} to 10^{-7}	Brown silty loam
	S-5	20.0 to 21.5	CL	10^{-6} to 10^{-8}	Dark grey silty loam
	S-9	40.0 to 41.5	CL	10^{-6} to 10^{-8}	Grey gravelly silty loam
	S-17	80.0 to 81.5	ML	10^{-3} to 10^{-6}	Light grey silt



USDA SOIL TEXTURAL CLASSIFICATION DIAGRAM*

Note: * Taken from USEPA, SW-705, October 1978.

UNIFIED SOIL CLASSIFICATION SYSTEM AND CHARACTERISTICS PERTINENT TO SLUDGE LANDFILLS*

Major Divisions		Symbol: Letter	Symbol: Hatching	Symbol: Color	Name	Potential Frost Action	Drainage Characteristics*	Value for Embankments	Permeability cm per sec	Compaction Characteristics †	Std AASHO Max Unit Dry Weight lb per cu ft †	Requirements for Seepage Control
COARSE-GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW		RED	Well-graded gravels or gravel-sand mixtures, little or no fines	None to very slight	Excellent	Very stable, pervious shells of dikes and dams	$k > 10^{-2}$	Good, tractor, rubber-tired steel-wheeled roller	125-135	Positive cutoff
		GP		RED	Poorly graded gravels or gravel-sand mixtures, little or no fines	None to very slight	Excellent	Reasonably stable, pervious shells of dikes and dams	$k > 10^{-2}$	Good, tractor, rubber-tired steel-wheeled roller	115-125	Positive cutoff
		GM		YELLOW	Silty gravels, gravel-sand-silt mixtures	Slight to medium	Fair to poor; Poor to practically impervious	Reasonably stable, not particularly suited to shells, but may be used for impervious cores or blankets	$k = 10^{-3}$ to 10^{-6}	Good, with close control, rubber-tired, sheepsfoot roller	120-135	Toe trench to none
		GC		YELLOW	Clayey gravels, gravel-sand-clay mixtures	Slight to medium	Poor to practically impervious	Fairly stable, may be used for impervious core	$k = 10^{-6}$ to 10^{-8}	Fair, rubber-tired, sheepsfoot roller	115-130	None
	SAND AND SANDY SOILS	SW		RED	Well-graded sands or gravelly sands little or no fines	None to very slight	Excellent	Very stable, pervious sections slope protection required	$k > 10^{-3}$	Good, tractor	110-130	Upstream blanket and toe drainage or wells
		SP		RED	Poorly graded sands or gravelly sands, little or no fines	None to very slight	Excellent	Reasonably stable, may be used in dike section with flat slopes	$k > 10^{-3}$	Good, tractor	100-120	Upstream blanket and toe drainage or wells
		SM		YELLOW	Silty sands, sand-silt mixtures	Slight to high	Fair to poor; Poor to practically impervious	Fairly stable, not particularly suited to shells but may be used for impervious cores or dikes	$k = 10^{-3}$ to 10^{-6}	Good, with close control, rubber-tired, sheepsfoot roller	110-125	Upstream blanket and toe drainage or wells
		SC		YELLOW	Clayey sands, sand-clay mixtures	Slight to high	Poor to practically impervious	Fairly stable, use for impervious core for flood control structures	$k = 10^{-6}$ to 10^{-8}	Fair, sheepsfoot roller, rubber-tired	105-125	None
FINE-GRAINED SOILS	SILTS AND CLAYS LL IS LESS THAN 50	ML		GREEN	Inorganic silts and very fine sands rock flour, silty or clayey fine sands or clayey silts with slight plasticity	Medium to very high	Fair to poor	Poor stability, may be used for embankments with proper control	$k = 10^{-3}$ to 10^{-6}	Good to poor, close control essential, rubber-tired roller, sheepsfoot roller	95-120	Toe trench to none
		CL		GREEN	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	Medium to high	Practically impervious	Stable, impervious cores and blankets	$k = 10^{-6}$ to 10^{-8}	Fair to good, sheepsfoot roller, rubber-tired	95-120	None
		OL		GREEN	Organic silts and organic silt-clays of low plasticity	Medium to high	Poor	Not suitable for embankments	$k = 10^{-4}$ to 10^{-6}	Fair to poor, sheepsfoot roller	80-100	None
	SILTS AND CLAYS LL IS GREATER THAN 50	MH		BLUE	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Medium to very high	Fair to poor	Poor stability, core of hydraulic dam, not desirable in rolled fill construction	$k = 10^{-4}$ to 10^{-6}	Poor to very poor, sheepsfoot roller	70-95	None
		CH		BLUE	Inorganic clays of high plasticity, fat clays	Medium	Practically impervious	Fair stability with flat slopes thin cores, blankets and dike sections	$k = 10^{-6}$ to 10^{-8}	Fair to poor, sheepsfoot roller	75-105	None
		OH		BLUE	Organic clays of medium to high plasticity, organic silts	Medium	Practically impervious	Not suitable for embankment.	$k = 10^{-6}$ to 10^{-8}	Poor to very poor, sheepsfoot roller	65-100	None
HIGHLY ORGANIC SOILS		Pt		Orange	Peat and other highly organic soils	NOT RECOMMENDED FOR SANITARY LANDFILL CONSTRUCTION						

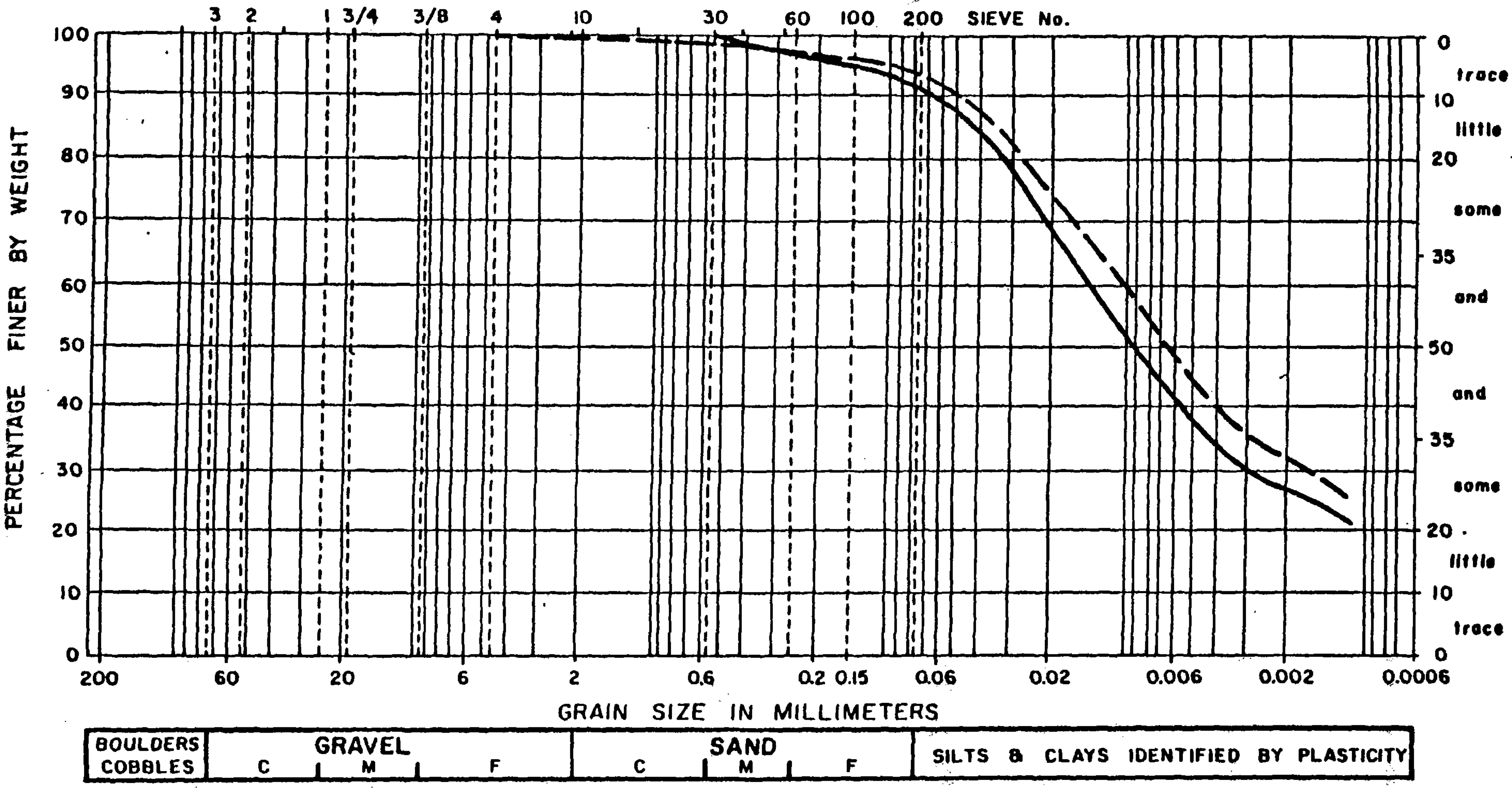
*Values are for guidance only; design should be based on test results

†The equipment listed will usually produce the desired densities after a reasonable number of passes when moisture conditions and thickness of lift are properly controlled.

†Compacted soil at optimum moisture content for Standard AASHO (Standard Proctor) compactive effort

Note: * Taken from USEPA, SW-705, October 1978.

GRAIN SIZE DISTRIBUTION

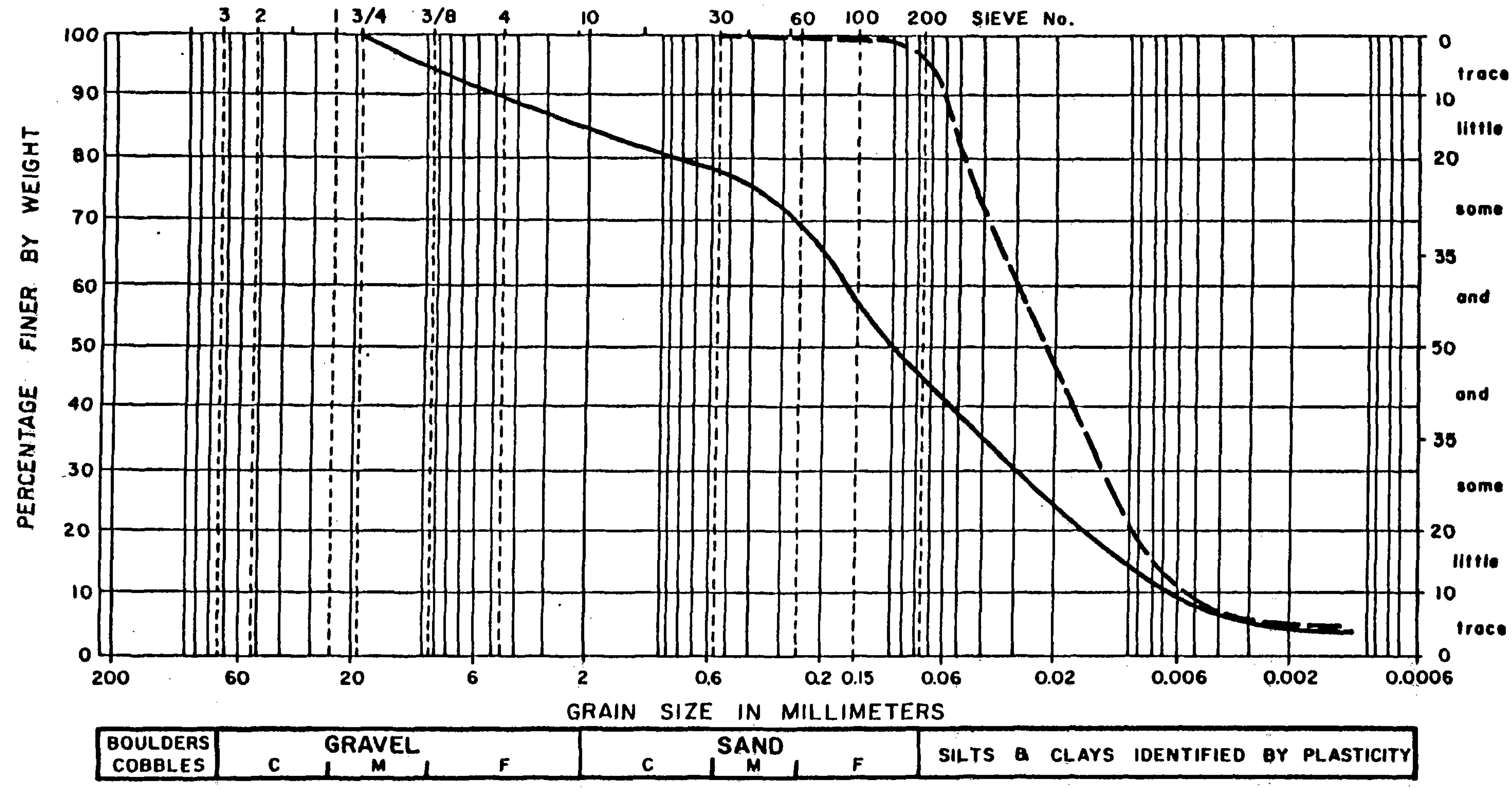


SYMBOL	BORING	SAMPLE	DEPTH	IDENTIFICATION
———	MW-1	S-1	0.0' - 1.5'	Dark brown Silty clay loam
— — —	MW-1	S-6	25.0' - 26.5'	Dark gray Silty clay loam

PROJECT LOCATION Lemont, Illinois BY G.P. DATE 5-11-81 PROJECT No. 81-06103-02

6-79

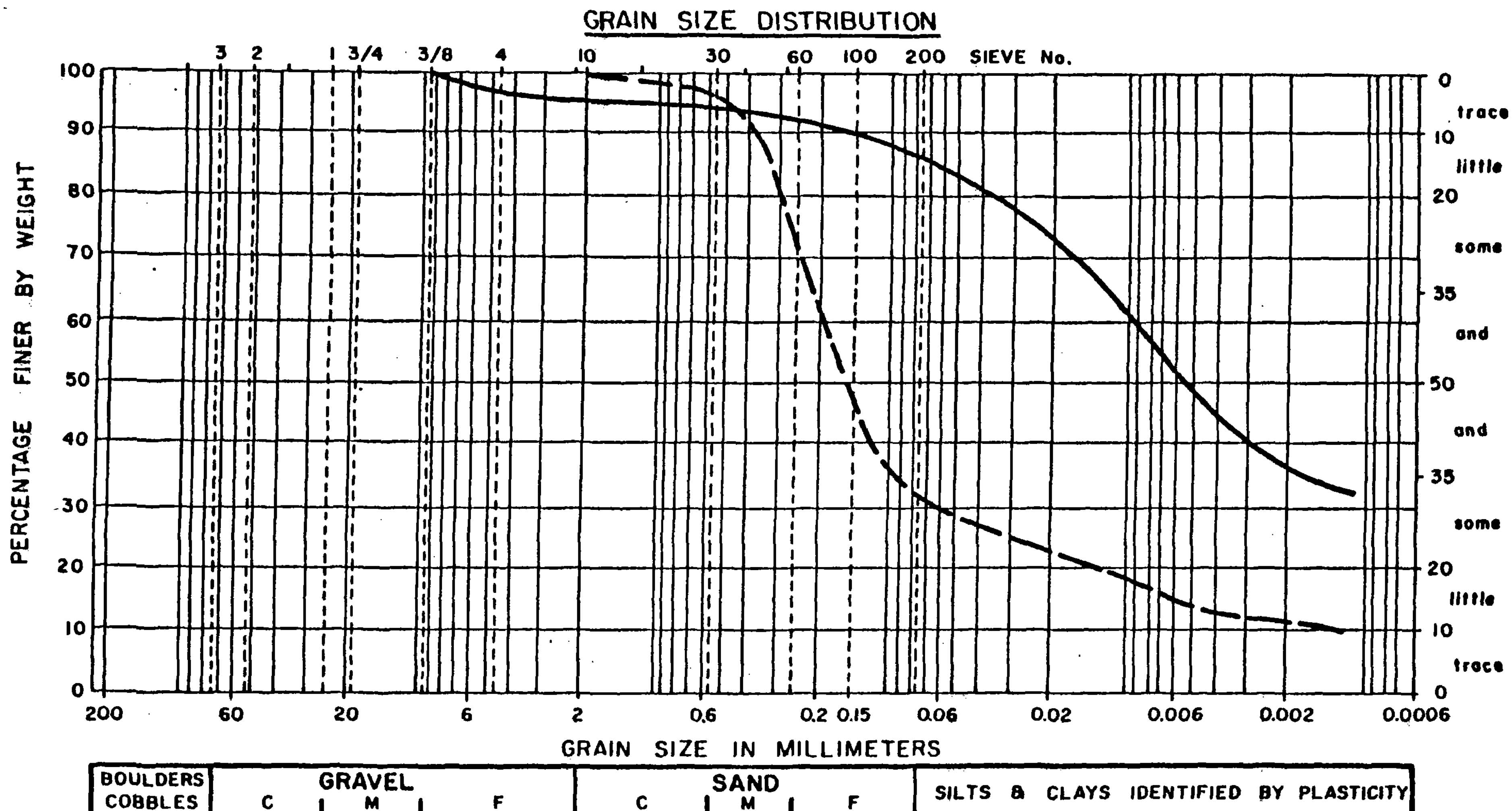
GRAIN SIZE DISTRIBUTION



SYMBOL	BORING	SAMPLE	DEPTH	IDENTIFICATION
————	MW-1	S-18	85.0' - 86.5'	Light gray Gravelly Silty loam
— — —	MW-1	S-21	100.0' - 101.5'	Light gray Silty loam

PROJECT LOCATION Lemont, Illinois BY G.P. DATE 5-11-81 PROJECT No. 81-06103-02

6-79

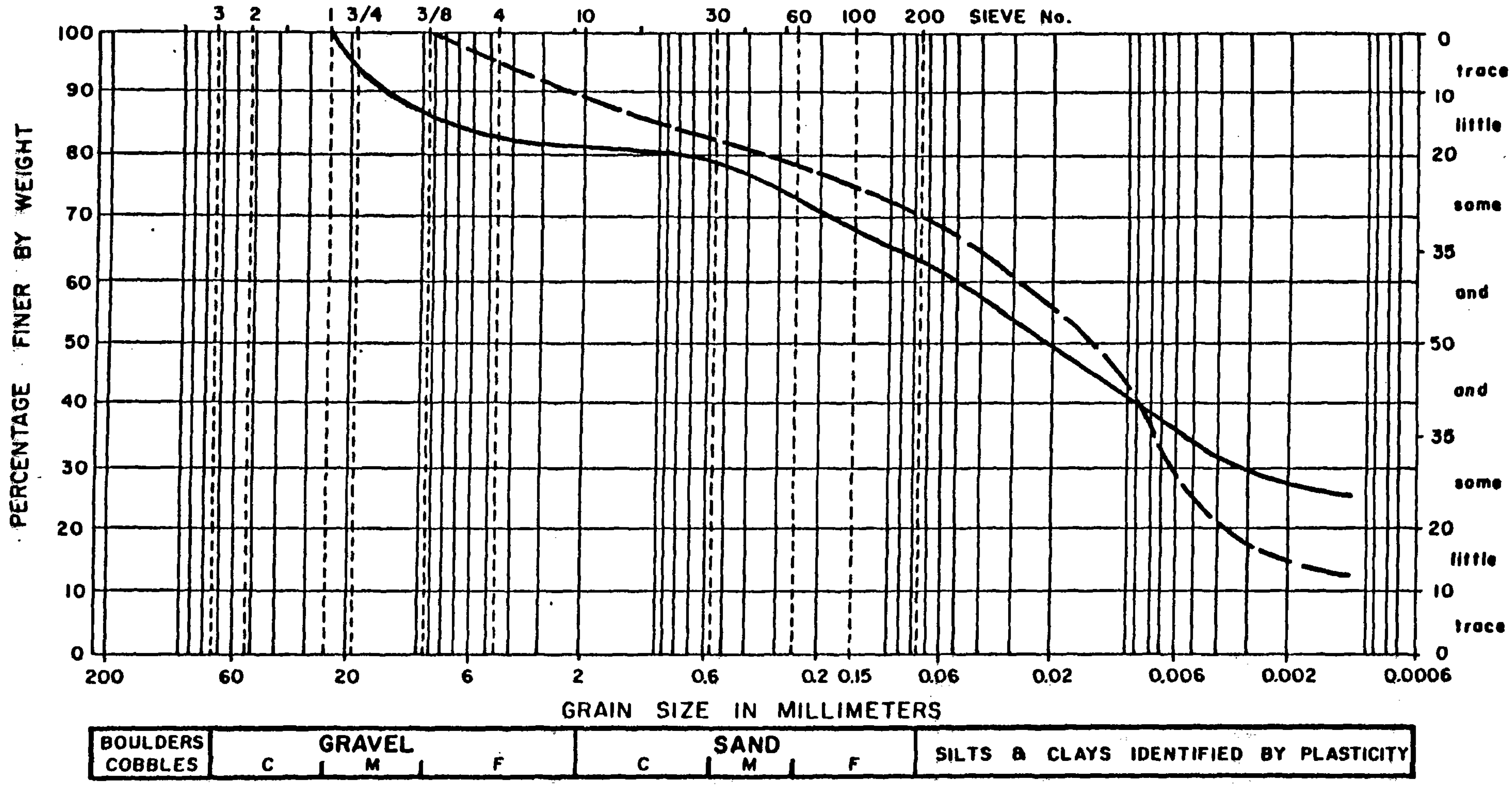


SYMBOL	BORING	SAMPLE	DEPTH	IDENTIFICATION
———	MW-2	S-1	0.0' - 1.5'	Brown Silty clay loam
— — —	MW-2	S-6	25.0' - 26.5'	Brown Sandy loam

PROJECT LOCATION Lemont, Illinois BY G.P. DATE 5-11-81 PROJECT No. 81-06103-02

6-79

GRAIN SIZE DISTRIBUTION

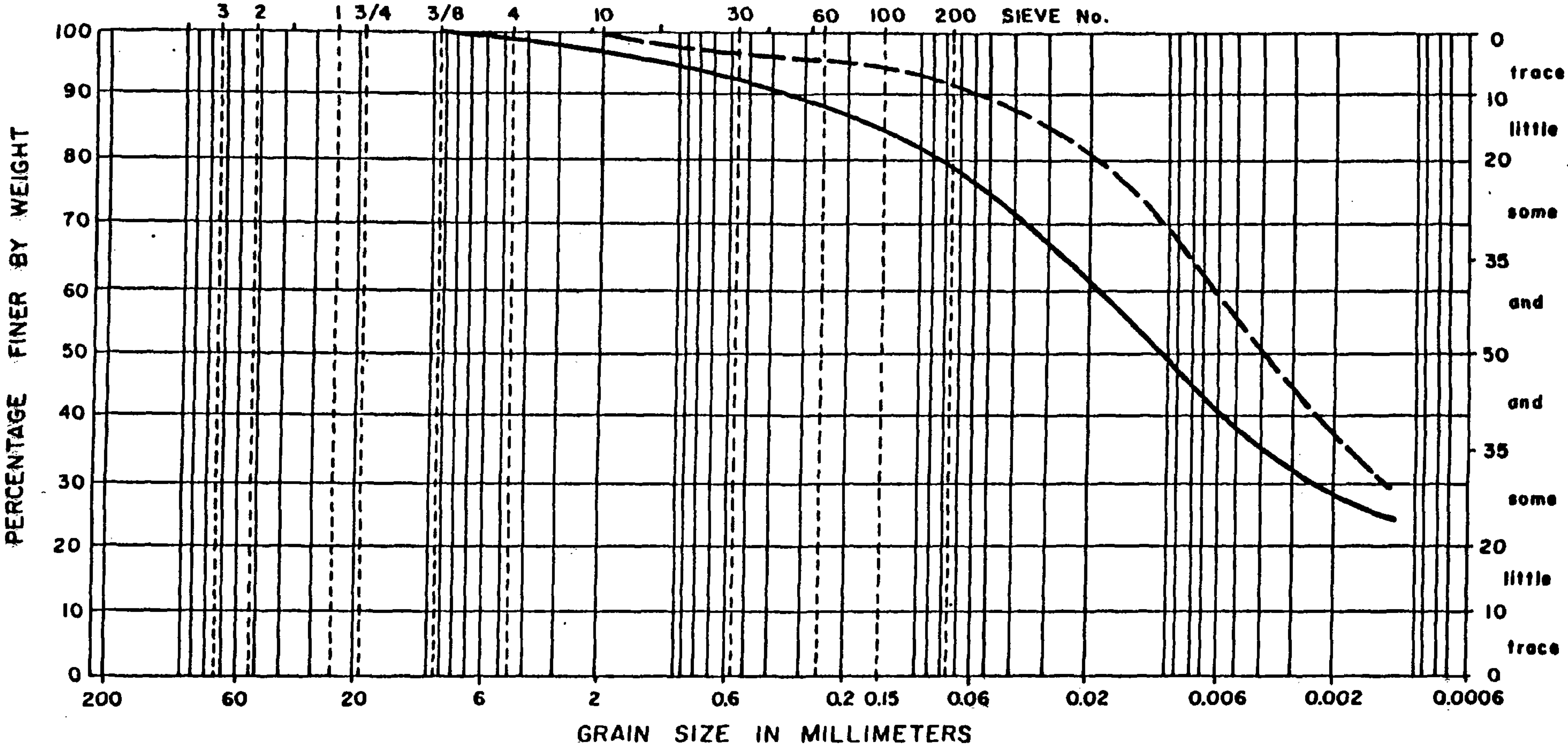


SYMBOL	BORING	SAMPLE	DEPTH	IDENTIFICATION
———	MW-2	S-18	85.0' - 86.5'	Light gray Gravelly Clay loam
— — —	MW-2	S-21	100.0' - 101.5'	Gray Gravelly Silty loam

PROJECT LOCATION Lemont, Illinois BY G.P. DATE 5-11-81 PROJECT No. 81-06103-02

6-79

GRAIN SIZE DISTRIBUTION

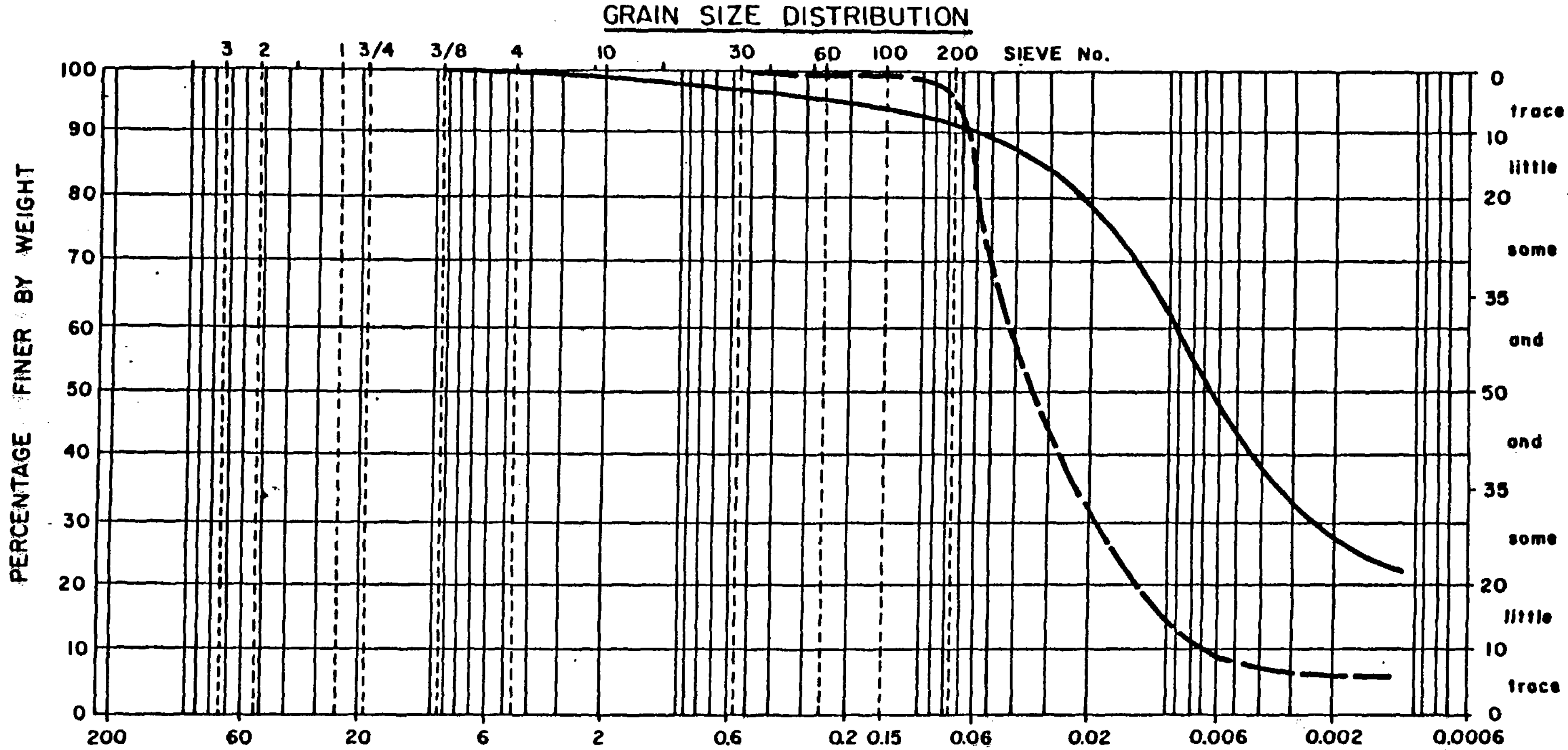


BOULDERS COBBLES	GRAVEL C	GRAVEL M	GRAVEL F	SAND C	SAND M	SAND F	SILTS & CLAYS IDENTIFIED BY PLASTICITY

SYMBOL	BORING	SAMPLE	DEPTH	IDENTIFICATION
———	MW-3	S-1	3.5' - 5.0'	Brown Silty clay loam
— — —	MW-3	S-6	29.5' - 30.0'	Dark gray Silty clay loam

PROJECT LOCATION Lemont, Illinois BY G.P. DATE 5-11-81 PROJECT No. 81-06103-02

6-79



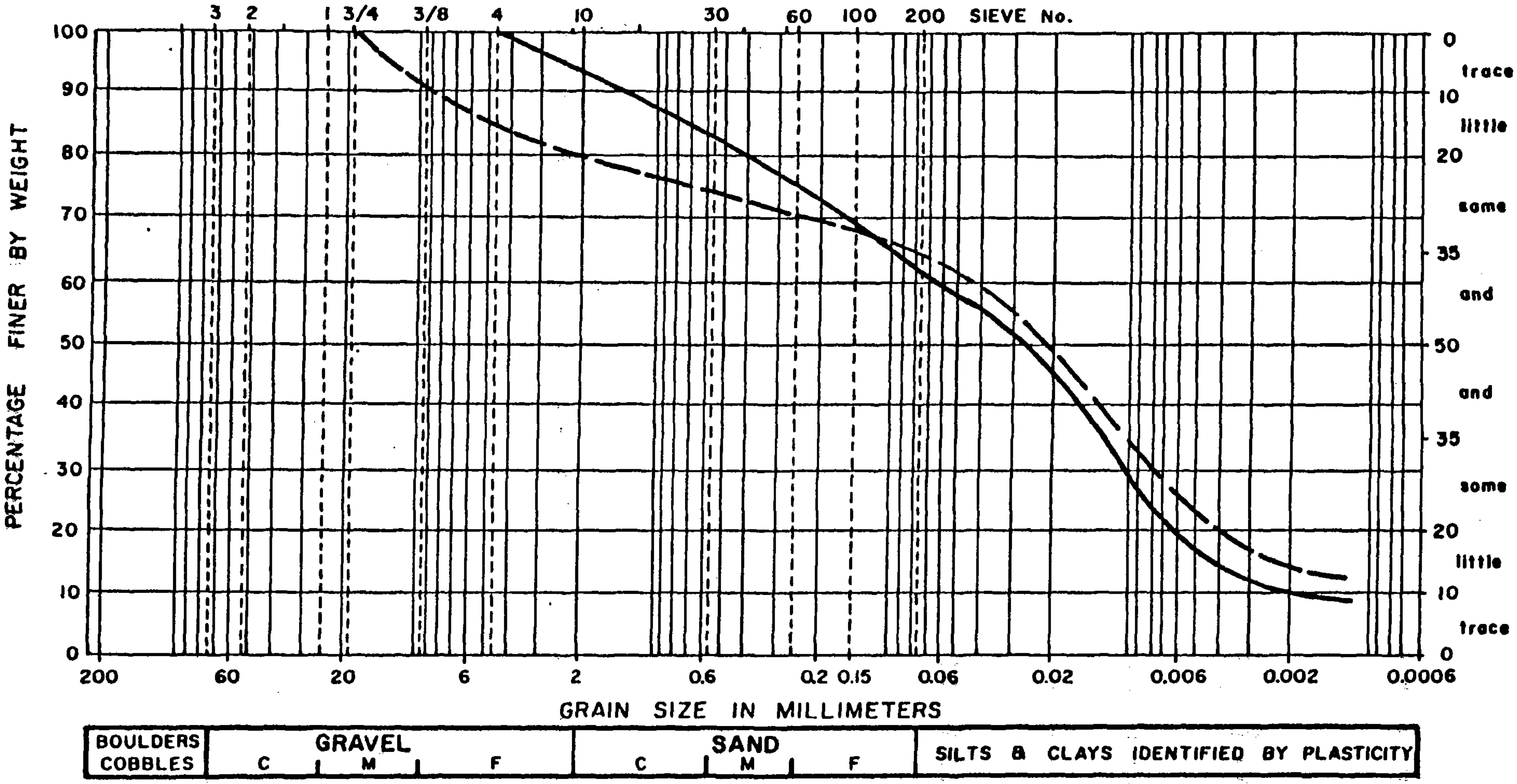
BOULDERS COBBLES	GRAVEL C	GRAVEL M	GRAVEL F	SAND C	SAND M	SAND F	SILTS & CLAYS IDENTIFIED BY PLASTICITY

SYMBOL	BORING	SAMPLE	DEPTH	IDENTIFICATION
———	MW-3	S-11	53.5' - 55.0'	Dark gray Silty clay loam
— —	MW-3	S-17	85.5' - 86.5'	Light gray Silt

PROJECT LOCATION Lemont, Illinois BY G.P. DATE 5-11-81 PROJECT No. 81-06103-02

6-79

GRAIN SIZE DISTRIBUTION

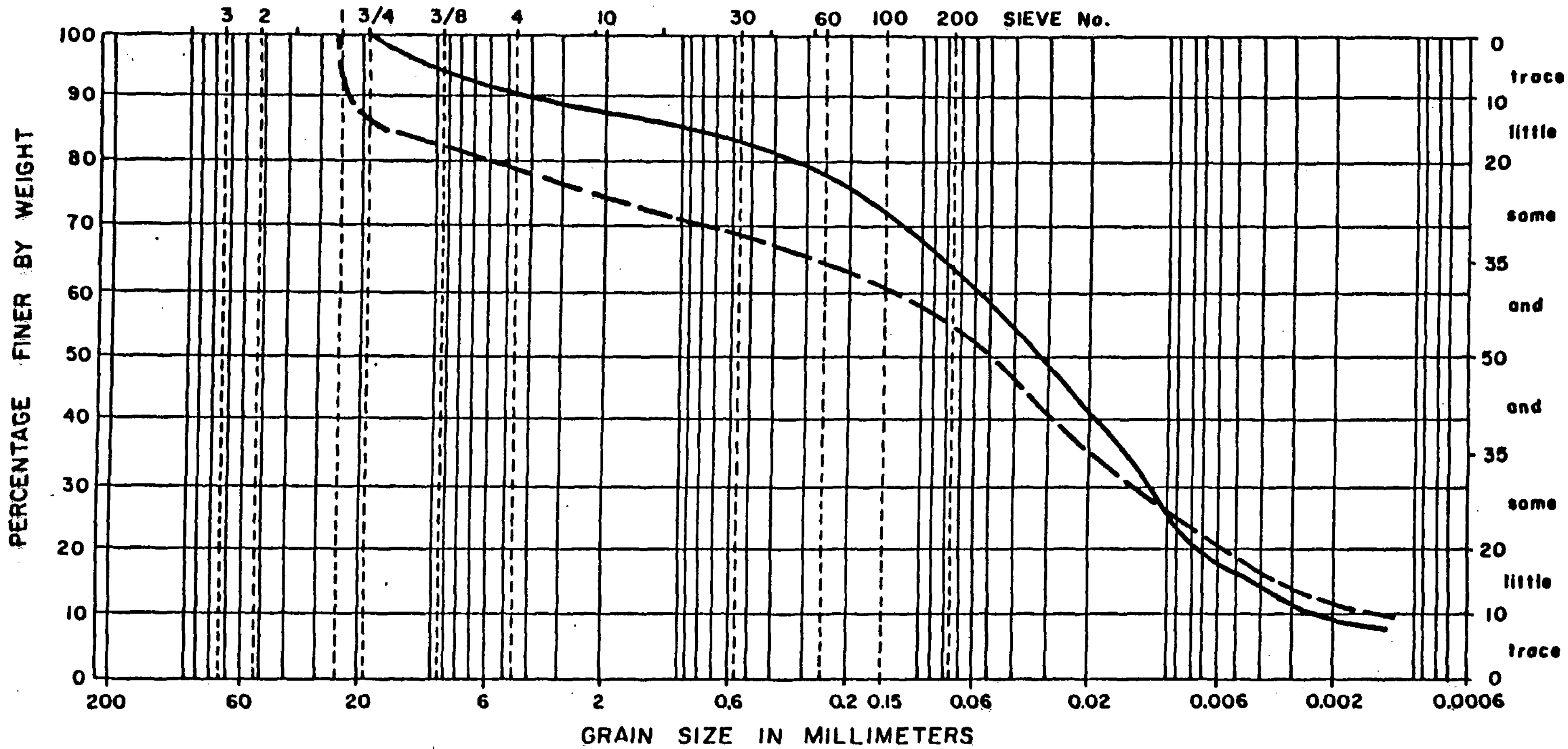


SYMBOL	BORING	SAMPLE	DEPTH	IDENTIFICATION
———— (solid)	MW-5	S-1	3.5' - 5.0'	Brown Silty loam
— — — (dashed)	MW-5	S-5	23.5' - 25.0'	Gray Gravelly Silty loam

PROJECT LOCATION Lemont, Illinois BY G.P. DATE 5-11-81 PROJECT No. 81-06103-02

6-79

GRAIN SIZE DISTRIBUTION



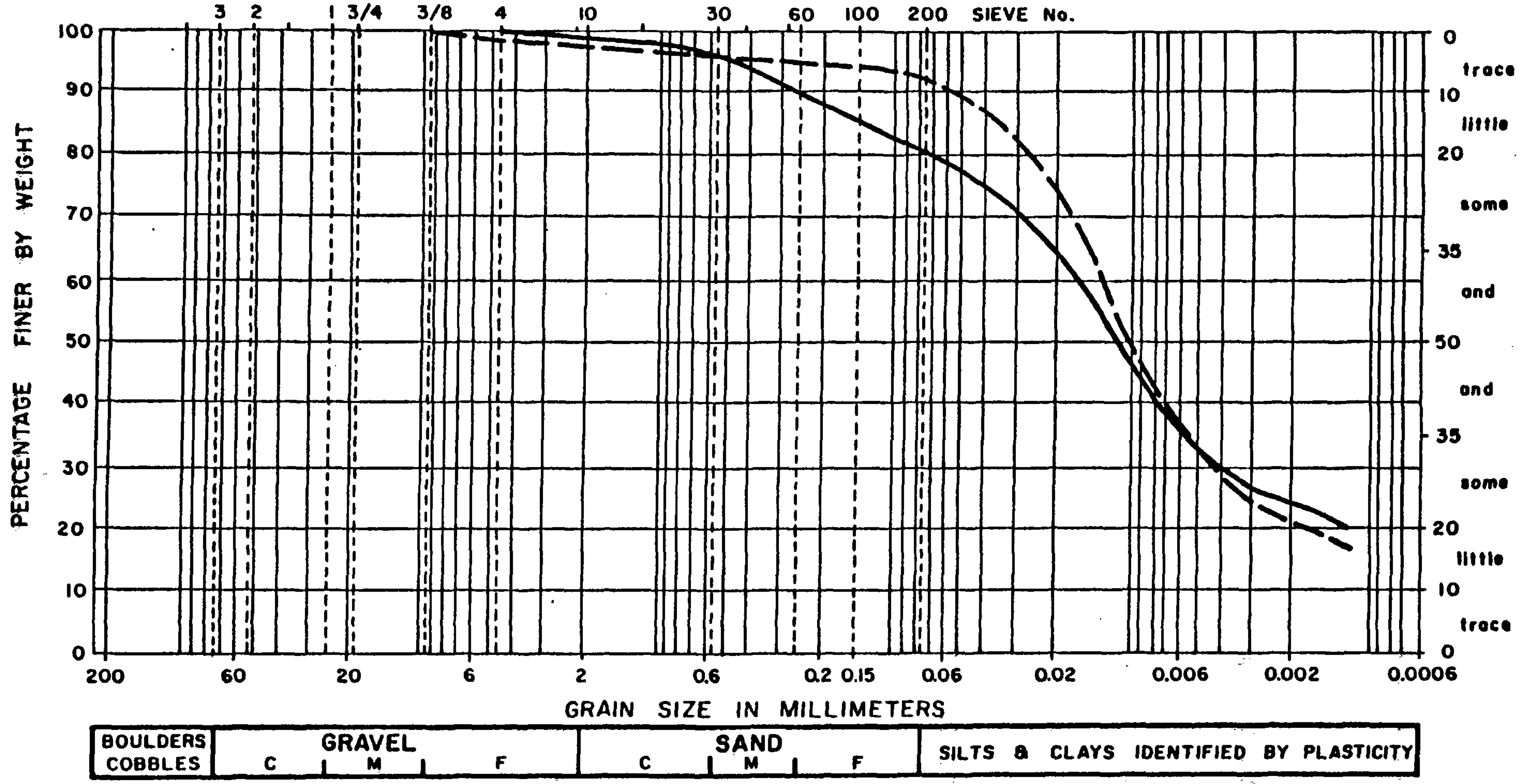
BOULDERS COBBLES	GRAVEL C	GRAVEL M	GRAVEL F	SAND C	SAND M	SAND F	SILTS & CLAYS IDENTIFIED BY PLASTICITY

SYMBOL	BORING	SAMPLE	DEPTH	IDENTIFICATION
———	MW-5	S-8	38.5' - 40.0'	Light gray Gravelly Silty loam
— — —	MW-5	S-15	73.5' - 75.0'	Light gray Gravelly Silty loam

PROJECT LOCATION Lemont, Illinois BY G.P. DATE 5-11-81 PROJECT No. 81-06103-02

6-79

GRAIN SIZE DISTRIBUTION

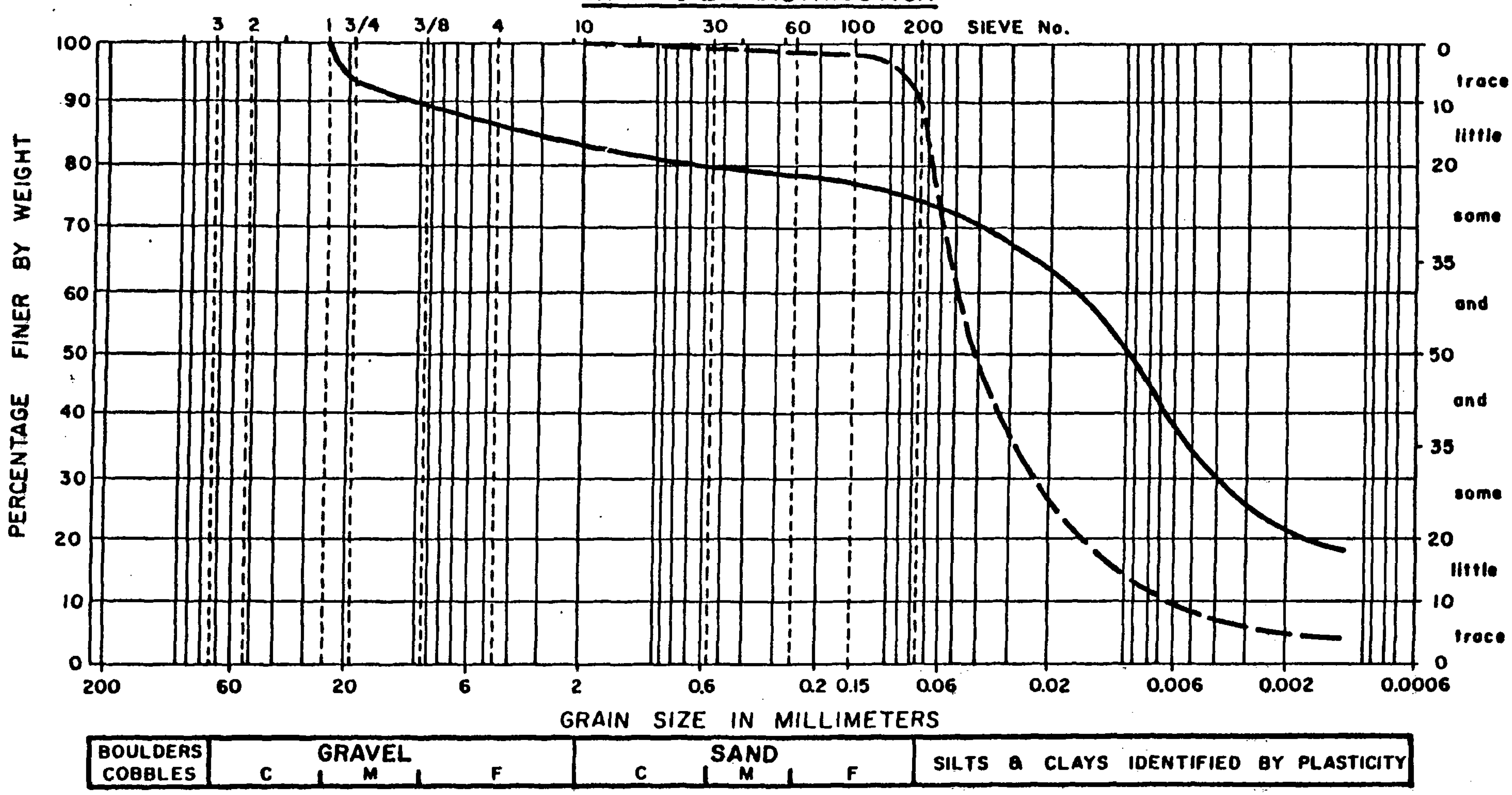


SYMBOL	BORING	SAMPLE	DEPTH	IDENTIFICATION
————	MW-6	S-1	0.5' - 2.0'	Brown Silty loam
— — —	MW-6	S-5	20.0' - 21.5'	Dark gray Silty loam

PROJECT LOCATION Lemont, Illinois BY G.P. DATE 5-11-81 PROJECT No. 81-06103-02

6-79

GRAIN SIZE DISTRIBUTION



SYMBOL	BORING	SAMPLE	DEPTH	IDENTIFICATION
	MW-6	S-9	40.0' - 41.5'	Gray Gravelly Silty loam
	MW-6	S-17	80.0' - 81.5'	Light gray Silt

PROJECT LOCATION Lemont, Illinois BY G.P. DATE 5-11-81 PROJECT No. 81-06103-02

6-79

UNOCAL RESPONSE
TO ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
JUNE 26, 1986 PRE-ENFORCEMENT CONFERENCE LETTER
ATTACHMENT B

1. IEPA Comment

Discrepancies in total depth were also noted for two of the wells during the inspection. SW7 is 20.41 feet shallower than when originally installed and SW4 is 4.62 feet greater than original borings indicate. Furthermore, the cement surface seal at SW9 must be repaired. These concerns must also be addressed during the Pre-Enforcement Conference.

Response

The discrepancies listed in Attachment "B" of the IEPA's June 25, 1986 letter have been investigated and the findings were:

1. SW-4. The boring log indicates the well to be approximately 56' from the casing top to the bottom of the hole. The measurement observed on July 3, 1986, was 56.3'. The Agency's measurement that the well is 4.6' deeper than the original is apparently in error.

2. SW-7. This well is approximately 20' shallower than originally installed and there appears to be a hard sandy layer 27' down. This portion of the well may have filled with sediment. Work is underway to remove the sediment by flushing the well. If this is unsuccessful, then the well will be redrilled. The Agency will be advised by September 30, 1986, on the status of this matter.

3. SW-9. The surface seal was found to be loose and has been repaired.

DWB:rm
9/12/86

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

REPLY TO THE ATTENTION OF:
5HE-12

DEC 17 1986

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

C.T. Corporation System
Registered Agent for
Union Oil Company of California
208 South LaSalle Street
Chicago, Illinois 60604

Re: Complaint, Findings of Violation
and Compliance Order
Union Oil, Chicago Refinery
ILD 041 550 567

Dear Sir/Madam:

Enclosed please find a Complaint and Compliance Order which specifies this Agency's determination of certain violations by Union Oil Company of California of the Resource Conservation and Recovery Act (RCRA), as amended, 42 U.S.C. §6901 et seq. This Agency's determination is based on an inspection on May 16, 1986, of the facility located at 135th Street and New Avenue in Lemont, Illinois by a representative of the Illinois Environmental Protection Agency (IEPA), and other information in our files. The Findings in the Complaint state the reasons for such a determination. In essence, the facility failed to meet particular requirements of RCRA relating to the develpment and implementation of an acceptable ground-water monitoring program according to regulations stated in 35 Ill. Adm. Code Part 725, Subpart F.

Accompanying the Complaint is a Notice of Opportunity for Hearing. Should you desire to contest the Complaint, a written request for a hearing is required to be filed with Ms. Beverely Shorty, Regional Hearing Clerk (5MF-14), United States Environmental Protection Agency (U.S. EPA), 230 South Dearborn Street, Chicago, Illinois 60604, within 30 days from receipt of this Complaint. A copy of your request should also be sent to Mary Hay, Office of Regional Counsel (5C-16), U.S. EPA at the above address.

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Regardless of whether you choose to request a hearing within the prescribed time limit following service of this Complaint, you are extended an opportunity to request an informal settlement conference.

If you have any questions or desire to request an informal conference for the purpose of settlement with Waste Management Division staff, please contact Jonathan Cooper, United States Environmental Protection Agency, RCRA Enforcement Section (5HE-12), 230 South Dearborn Street, Chicago, Illinois 60604. His phone number is (312) 886-4464.

Sincerely,

Basil G. Constantelos

Basil G. Constantelos, Director
Waste Management Division

Enclosure

cc: Gary King, IEPA
Harry Chappel, IEPA
Glenn Savage, IEPA

D. W. Bruckert
Union Oil Company
Chicago Refinery
Lemont, Illinois 60439

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION V

IN THE MATTER OF:	)	
	)	DOCKET NO.
UNION OIL COMPANY OF CALIFORNIA	)	
135th STREET AND NEW AVENUE	)	COMPLAINT, FINDINGS OF
LEMONT, ILLINOIS 60439	)	VIOLATION AND COMPLIANCE ORDER
ILD 041 550 567	)	
	)	

V-W- 87 R-015

This Complaint is filed pursuant to Section 3008(a)(1) of the Resource Conservation and Recovery Act of 1976, as amended (RCRA), 42 U.S.C. §6928(a)(1) and the United States Environmental Protection Agency's Consolidated Rules of Practice Governing the Administrative Assessment of Civil Penalties and the Revocation or Suspension of Permits, 40 CFR Part 22. The Complainant is the Director, Waste Management Division, Region V, United States Environmental Protection Agency (U.S. EPA). The Respondent is Union Oil Company of California, Lemont, Illinois 60439.

This Complaint is based on information obtained by the U.S. EPA, including a compliance inspection conducted by the Illinois Environmental Protection Agency (IEPA) on May 16, 1986. At the time of the inspection, violations of applicable State and Federal regulations were identified.

Pursuant to 42 U.S.C. §6928(a)(1), and based on the information cited above, it has been determined that Union Oil has violated: (1) Subtitle C of RCRA, Section 3004, 42 U.S.C. §6924; (2) Title V of the Illinois Environmental Protection Act, Ill. Rev. Stat. 1983, Chapter 111 1/2, Paragraph 1001 et seq., as amended; and (3) regulations adopted by the Illinois Pollution Control Board, found at 35 Ill. Adm. Code Part 725.

JURISDICTION

Jurisdiction for this action is conferred upon U.S. EPA by Sections 1006(a), 2002(a)(1), 3006(b), and 3008 of RCRA, 42 U.S.C. §6905(a), §6912(a)(1), §6926(b), and §6928 respectively.

On January 30, 1986, the State of Illinois was granted final authorization by the Administrator of U.S. EPA, pursuant to Section 3006(b) of RCRA, 42 U.S.C. §6926(b), to administer a hazardous waste program in lieu of the Federal program. See 51 Federal Register 3778 (1986). As a result, facilities in Illinois qualifying for interim status under 40 CFR 270.70 and facilities applying for a RCRA permit are regulated under the Illinois provisions found at 35 Ill. Adm. Code Part 720 et seq. rather than the Federal regulations set forth at 40 CFR Parts 265 and 270. Section 3008(a)(2) of RCRA, 42 U.S.C. §6928(a)(2), provides that U.S. EPA may enforce state regulations in those states authorized to administer a hazardous waste program. Notice to the Illinois Enviromental Protection Agency pursuant to this section has been provided by U.S. EPA.

FINDINGS OF VIOLATION

This determination of violation is based on the following:

1. Respondent, Union Oil Company of California, is a person defined by Section 1004(15) of RCRA, 42 U.S.C. §6903(15) and 35 Ill. Adm. Code 720.110 who owns and operates a facility at 135th Street and New Avenue in Lemont, Illinois that generates, treats, and disposes of hazardous waste.

2. Section 3010(a) of RCRA, 42 U.S.C. §6930(a), requires any person who generates or transports hazardous waste, or owns or operates a facility for the treatment,

storage, or disposal of hazardous waste, to notify U.S. EPA of such activity within 90 days of the promulgation of regulations under Section 3001 of RCRA. Section 3010 of RCRA also provides that no hazardous waste subject to regulations may be transported, treated, stored or disposed of unless the required notification has been given.

3. U.S. EPA first published regulations concerning the generation, transportation, treatment, storage or disposal of hazardous waste on May 19, 1980. These regulations are codified at 40 CFR Parts 260 through 265. Notification to U.S. EPA of hazardous waste activity was required in most instances no later than August 18, 1980.

4. Section 3005(a) of RCRA requires U.S. EPA to publish regulations requiring each person owning or operating a hazardous waste treatment, storage, or disposal facility to obtain a RCRA Permit. Such regulations were published on May 19, 1980, and are codified at 40 CFR Parts 270 and 271 (formerly Parts 122 and 123). The regulations require that persons who treat, store, or dispose of hazardous waste submit Part A of the permit application in most instances no later than November 19, 1980.

5. Section 3005(e) of RCRA provides that an owner or operator of a facility shall be treated as having been issued a permit pending final administrative disposition on the permit application provided that: (1) the facility was in existence on November 19, 1980; (2) the requirements of Section 3010(a) of RCRA concerning notification of hazardous waste activity have been complied with; and (3) an application for a permit has been made. This statutory

authority to operate is known as interim status. U.S. EPA regulations implementing these provisions are found at 40 CFR Part 270.

6. The Respondent, Union Oil Company of California, owns and operates a facility at 135th and New Avenue in Lemont, Illinois known as the Chicago Refinery. The Respondent is a California corporation whose registered agent in Illinois is C.T. Corporation System, 208 South LaSalle Street, Chicago, Illinois 60604.

7. On August 15, 1980, Respondent filed a notification of hazardous waste activity for this facility with U.S. EPA pursuant to Section 3010 of RCRA. On November 17, 1980, Respondent filed Part A of the permit application with the U.S. EPA pursuant to Section 3005 of RCRA. The Part A permit application identifies the hazardous waste management processes as storage in containers (S01), storage in surface impoundments (S04), and disposal by land application (D81). The facility describes its hazardous waste as "API separator sludge from the petroleum refining industry." These wastes have been identified and listed as hazardous wastes under Section 3001 of the Act (U.S. EPA Hazardous Waste No. K051) because of the hazardous constituents hexavalent chromium and lead.

8. As a result of the determinations set forth in Finding 7, U.S. EPA has determined that Respondent's facility has interim status pursuant to Section 3005(e) of RCRA and may operate as a hazardous waste management facility under the interim status provisions of 40 CFR §270.70.

9. On May 16, 1986, representatives of IEPA conducted a compliance inspection of Respondent's Lemont facility. During that inspection, the Chicago

Refinery was determined to be in violation of ground-water monitoring requirements as set forth at 35 Ill. Adm. Code Part 725, Subpart F. Specifically, the following violations, for which a penalty is being assessed, were identified:

a. Failure to implement a ground-water monitoring program capable of determining the facility's impact on the quality of ground water in the uppermost aquifer underlying the facility, as required by 35 Ill. Adm. Code 725.190(a). The number, depth, and construction of current monitoring wells are inadequate for making such a determination.

b. Failure to install a ground-water monitoring system which meets the requirements of 35 Ill. Adm. Code 725.191, as required by Section 725.190(b).

c. Failure to install an adequate number of upgradient wells by which to sufficiently characterize the background ground-water quality in the uppermost aquifer near the facility and assure that the wells are not affected by the facility, as required by 35 Ill. Adm. Code 725.191(a)(1). Ground-water contour maps submitted by Respondent and ground-water elevations from Annual Reports indicate a mounding effect occurring around the land treatment area at MW-3 and probable ground-water flow toward monitoring wells MW-9 and MW-2 which Respondent claims are upgradient.

d. Failure to install an adequate number of downgradient wells at the limit of the waste management area. The numbers, locations, and depths of wells must ensure immediate detection of any statistically significant amounts of hazardous waste or hazardous waste constituents that migrate to the uppermost aquifer from the waste management area, as required by 35 Ill. Adm. Code 725.191(a)(2). Specifically, the facility is required to install detection monitoring wells as close as physically possible to the edge of hazardous waste management areas/units. Two of the four monitoring wells which are considered to be downgradient (MW-5 and MW-8) are greater than 200 feet from the indicated limits of the hazardous waste management areas. The locations of those wells are unacceptable because they do not ensure immediate detection of contaminant release from the hazardous waste management areas.

e. Failure to appropriately screen and sand pack well casings to enable collection of acceptable, representative ground-water samples, as required by 35 Ill. Adm. Code 725.191(c). Existing monitoring wells have been installed in a manner which is unacceptable because they have:

   i. Large screened intervals (20 to 30 feet);

   ii. Excessive sand packs (up to 40 feet);

   iii. Screened intervals encompassing two or more lithologic zones which may have different potentiometric heads and/or significantly different hydraulic conductivities; sampling under such conditions can yield unrepresentative concentrations of contaminants in the ground water; and

   iv. The annular space above the sampling depth is sealed with natural clay, an unsuitable material to prevent contamination of samples and the ground water.

10. Respondent has submitted Part B of the permit application and certified

compliance with applicable ground-water monitoring and financial responsibility requirements by November 8, 1985, as required by Section 3005(e)(2) of RCRA. RCRA regulated land disposal units that fail to meet the requirements of Section 3005(e)(2) lose interim status and must immediately cease operation and comply with applicable closure requirements. At the time of certification, Respondent was in assessment ground-water monitoring and the violations cited in Finding 9 were not alleged by IEPA.

COMPLIANCE ORDER

Respondent having been initially determined to be in violation of the above cited rules and regulations, the following Compliance Order pursuant to Section 3008 of RCRA, 42 U.S.C. §6928, is entered:

A. Respondent shall, within thirty (30) days of this Order becoming final, submit to IEPA and U.S. EPA for approval, a plan for performance of additional subsurface investigation at the Lemont facility. The plan must specify:

1. Methodology which will be used to investigate site-specific geology and hydrology in order to yield:
   a. Site-specific aquifer hydraulic properties determined by slug tests or pumping tests; and
   b. Potentiometric surface maps from which ground-water flow direction and gradient can be more clearly delineated for purposes of evaluating the validity of the "upgradient" designation of two of Respondent's wells.
2. An implementation schedule.

Upon approval of this plan by IEPA and U.S. EPA, Respondent shall implement the plan in accordance with the approved schedule.

B. Respondent shall, within thirty (30) days from completion of the additional subsurface investigation, submit to the IEPA and U.S. EPA for approval a plan for a revised ground-water monitoring system. The revised system proposed must address the deficiencies enumerated by IEPA following the ground-water compliance inspection on May 16, 1986, including concerns regarding the locations, number, depth, and construction of wells. An implementation schedule must be included in the plan. Wells in Respondent's proposed ground-water monitoring system must be capable of immediately detecting any hazardous waste or hazardous waste constituents that migrate from the waste management area to the uppermost aquifer. The system must consist of the following monitoring wells screened in the uppermost aquifer:

1. At least one background monitoring well nest installed hydraulically upgradient (i.e., in the direction of increasing static head) from the limit of the waste management area. The well nest(s) should monitor at least two depth-discrete zones by screening one zone totally within the dolomite bedrock and another in the unconsolidated silty/sandy units above bedrock at an elevation of about 630 feet. The upgradient well(s) must yield ground-water samples that are:

    a. Representative of background ground-water quality in the uppermost aquifer (including all lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary); and

    b. Not affected by the facility due to any possible mounding of the ground-water surface beneath the land treatment area.

2. A series of monitoring well nests hydraulically downgradient of the waste management area at the limit of the land treatment area. The number, spacings, locations, and depths must ensure that they will immediately detect any statistically significant amounts of hazardous waste or hazardous waste constituents that migrate from the waste management area to the uppermost aquifer (including all lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary). Wells should be placed along all three downgradient boundaries (i.e., the west, north, and east sides).

3. Monitoring wells must be cased in a manner that maintains the integrity of the monitoring well bore hole. This casing must be screened or perforated and packed with gravel or sand where necessary, and with proper screened lengths to enable sample collections at depths where appropriate aquifer flow zones exist. Well nests must be installed with screened intervals within specific lithologic units of the uppermost aquifer particularly if hydraulic conductivities of units are dissimilar. The annular spaces above screened zones must be sealed with a suitable material (e.g., cement grout or bentonite slurry) to prevent contamination of samples and the ground water.

C. Upon receipt of approval from IEPA and U.S. EPA of the new ground-water monitoring plan, Respondent shall install the new wells as approved and in accordance with the time schedule stipulated.

D. Respondent shall notify U.S. EPA in writing upon achieving compliance with this Order and any part thereof. This notification shall be submitted no later than the time stipulated above to the U.S. EPA, Region V, Waste Management Division, 230 South Dearborn Street, Chicago, Illinois 60604. Attention: Jonathan Cooper, (5HE-12), RCRA Enforcement Section.

A copy of these documents and all correspondence with U.S. EPA regarding this Order shall also be submitted to Mr. Gary King, Senior Attorney, Illinois Environmental Protection Agency, Division of Land Pollution Control, 2200 Churchill Road, Springfield, Illinois 62706.

Notwithstanding any other provision of this Order, an enforcement action may be brought pursuant to Section 7003 of RCRA or other statutory authority where the handling, storage, treatment, transportation, or disposal of solid or hazardous waste at this facility may present an imminent and substantial endangerment to human health or the environment.

PROPOSED CIVIL PENALTY

In view of the above determination and consideration of the seriousness of the violations cited herein, the potential harm to human health and the environment, the continuing nature of the violations, and the ability of the Respondent to pay penalties, the Complainant proposes to assess a civil penalty in the amount of NINE THOUSAND FIVE HUNDRED DOLLARS ($9,500) against the Respondent, Union Oil Company of California pursuant to Sections 3008(c) and 3008(g) of RCRA, 42 U.S.C. §6928. Payment shall be made by certified or cashier's check payable to the Treasurer of the United States and shall be mailed to U.S. EPA, Region V, P.O. Box 70753, Chicago, Illinois 60673. Copies of the transmittal of the payment should be sent to both the Regional Hearing Clerk, Planning and Management Division, and the Solid Waste and Emergency Response Branch Secretary Office of Regional Counsel, U.S. EPA, 230 South Dearborn Street, Chicago, Illinois 60604.

Failure to comply with any requirements of the Order shall subject the above-named Respondent to liability for a civil penalty of up to TWENTY-FIVE THOUSAND DOLLARS ($25,000) for each day of continued noncompliance with the deadlines contained in this Order. U.S. EPA is authorized to assess such penalties pursuant to RCRA Section 3008(c).

NOTICE OF OPPORTUNITY FOR HEARING

The above-named Respondent has the right to request a hearing to contest any material factual allegation set forth in the Complaint and Compliance Order or the appropriateness of any proposed compliance schedule or penalty. Unless said Respondent has requested in writing a hearing not later than thirty (30) days from the date this Complaint is served, Respondent may be found in default of the above Complaint and Compliance Order.

To avoid a finding of default by the Regional Administrator you must file a written answer to this Complaint with the Regional Hearing Clerk, Planning and Management Division, U.S. EPA Region V, 230 South Dearborn Street, Chicago, Illinois 60604, within thirty (30) days of receipt of this notice. A copy of your answer and any subsequent documents filed in this action should be sent to Mary Hay, Assistant Regional Counsel, at the same address. Failure to answer within thirty days of receipt of this Complaint may result in a finding by the Regional Administrator that the entire amount of penalty sought in the Complaint is due and payable and subject to the interest and penalty provisions contained in the Federal Claims Collection Act of 1966, 31 U.S.C. §§3701 et seq.

Your answer should clearly and directly admit, deny, or explain each of the factual allegations of which Respondent has knowledge. Said answer should contain (1) a definite statement of the facts which constitute the grounds of defense, and (2) a concise statement of the facts which Respondent intends to place at issue in the hearing. The denial of any material fact, or the raising of any affirmative defense, shall be construed as a request for a hearing.

The Consolidated Rules of Practice Governing the Administrative Assessment of Civil Penalties and the Revocation or Suspension of Permits, 40 CFR Part 22, are applicable to this administrative action. A copy of these Rules is enclosed with this Complaint.

SETTLEMENT CONFERENCE

Whether or not Respondent requests a hearing, Respondent may confer informally with U.S. EPA concerning: (1) whether the alleged violations in fact occurred as set forth above; (2) the appropriateness of the compliance schedule; and (3) the appropriateness of any proposed penalty in relation to the size of Respondent's business, the gravity of the violations, and the effect of the proposed penalty on Respondent's ability to continue in business. Respondent may request an informal settlement conference at any time by contacting this office. Any such request, however, will not affect either the thirty-day time limit for responding to this Complaint or the thirty-day time limit for requesting a formal hearing on the violations alleged herein.

U.S. EPA encourages all parties to pursue the possibilities of settlement through informal conferences. A request for an informal conference should be made in writing to Jonathan Cooper, RCRA Enforcement Section (5HE-12), at the address cited above, or by calling him at (312) 886-4464.

Dated this 12th day of December, 1986.

Basil G. Constantelos, Director
Waste Management Division
Complainant
U.S. Environmental Protection Agency
Region V

CERTIFICATE OF SERVICE

I hereby certify that I have caused a copy of the foregoing Complaint to be served upon the persons designated below, on the date below, by causing said copies to be deposited in the U.S. Mail, First Class and certified-return receipt requested, postage prepaid, at Chicago, Illinois, in envelopes addressed to:

C.T. Corporation System
Registered Agent for
Union Oil of California
208 South LaSalle Street
Chicago, Illinois 60604

Mr. D. W. Bruckert
Union Oil Company
Chicago Refinery
135th Street and New Avenue
Lemont, Illinois 60439

I have further caused the original of the Complaint and this Certificate of Service to be served in the Office of the Regional Hearing Clerk located in the Planning and Management Division, U.S. EPA, Region V, 230 South Dearborn Street, Chicago, Illinois 60604, on the date below.

These are said persons' last known addresses to the subscriber.

Dated this 17 day of December, 1986.

Alan Sharp, for
Secretary, Hazardous Waste Enforcement Branch
U.S. EPA, Region V